BIBILIOGRAPHY

1. Dharmadasa, I.M.2009. A Future Dominated by Solar Energy. Sheffield Hallam University, Sheffield, U.K.

2. Dharmadasa, I.M.2009. Solar Energy Technologies: A Status Report. Sheffield Hallan University, Sheffield, U.K.

3. Gratzel, Michael, O'Regan Brian. 1991. A low cost, high efficiency solar cells based on Dye Sensitized colloidal Ti O_2 film, Institute of Technology CH1015, Lausane, Switzerland, Letters to Nature, Magazine, Nature 359 (737-740).

4. Gratzel, Michael.2005.Solar Energy Conversion by Dye-Sensitized Photovoltaic Cells, Inorganic Chemistry. Vol 44, P 6841-6851.

5. Guo, Ying., Huang, Lu., Portar, Alan L., 2009. Profiling Research Patterns for a New and Emerging Science and Technology: Dye-Sensitized Solar Cells, Beijing Institute of Technology, Beijing, Peoples Republic of China and Georgia Institute of Technology, Atlanta, U.S.A., sma.tech.edu/bitstream/handle/1853/3237/22-656-PB.pdf

6. Grätzel, M., 2003. Dye-sensitized solar cells. Journal of Photochemistry and Photobiology C: Photochemistry Reviews (4), 145-153.

7. Smested, G.P., 1998. Education and solar conversion:
Demonstrating electron transfer. Solar Energy Materials & Solar Cells 55, 157-178.

8. Hao, S., Wu, J., Huang, Y., Lin, J., 2006. Natural dyes as photo sensitizers for dye-sensitized solar cells. Sol. Energy 80, 209-214.

9. Kudagamage, K., 2008. Botanical Names and Sinhala Names of plants grown in Sri Lanka.Horticultural Crop Research & Development Institute, Gannoruwa, Sri Lanka.

10. Weerasinghe, A. Botany of Crops. Rajarata University, Sri Lanka.

11. Hasan,M.S., Roy,S., Corkish,R., 2010. Sustainable Energy in Asia and the Pacific:Emerging Technologies and Research Priorities in Solar Energy (DSSC"s), 28- 33.

12. Chmiel, G., Gehring, J., Uhlendorf, I., Jestel, D., 1998. Dye-Sensitized solar cells: Progress towards applications. Proceedings for the 2nd World Conference PVSEC, Vienna, Austria, 53-57.

13. Jihuci, Wv., Zhang, Lan., Sanachu, Hao., Pingziang, Li., Jia, Ming, Lin., Huang, M., Huang, Y., 2008. Progress on the Electrolytes for DSSC's. Pure Applied Chemistry Vol 80, No 11, 2245 – 2258.

14. Cambell, R., Wayne. D.R., 2007.Taking Natures' use of cheap Solar Power.Massey University, Nanotechnology Research Centre, New Zealand. Science Direct 6 April 2007.

15. Tennakone, K., Kumara, G.R.R.A., Kottegoda, I.R.M., Perera, V.P.S., Weerawardana, P.S.R.S., 1998. Sensitization of nanoporous film of TiO_2 with Santalin (red sandalwood pigment) and construction of dye sensitized solid-state photovoltaic cells. Journal of Photochemistry & Photobiology, 117(1998), 137-142.

16. Tennakone, K., Perera, V.P.S., Kottegoda, I.R.M., Kumara, G.R.R.A., 1998. Dye-sensitized solid state photovoltaic cell based on composite Zinc oxide/Tin oxide film. Journal of Physics., 32 (1999), 374-379.

17. Tennakone, K., Kumara, G.R.R., Kottagoda, I.R.M., Perera, V.P.S., 1999. An efficient dye-sensitized photoelectrochemical solar cell made from oxide of Tin and Zinc. Chemical Communication, 1999,15-16.

18. Tennakone, K., Kottagoda, SenadheeraG.K.R., Perera, V.P.S., Kottagoda, I.R.M., de Silva, L.A.A., 1999. Dye-Sensitized photoelectrochemical cells based on porous. SnO_2/ZnO composite and TiO_2 film is a Polymer electrolyte. American Chemical Society, Chen. Mater 1999, 2474 – 2477.

19. Tennakone, K., Kottagoda, I.R.M., de Silva, L.A.A., Perea, V.P.S., 1999. The possibility of ballistic electron transport in dye-sensitized semiconductor nano-crystalline particles aggregates. Semiconductor Science & Technology 14 (1999), 975 – 978.

20. Tennakone, K., Bandara, J., Photocatalytic activity of dye-sensitized Tin oxide nanocrystalline particles attached to Zinc oxide particles: Long distance electron transfer via ballistic transport of electrons across nanocrystallites. Applied Catalysis A: General 208 (2001) 335-341.

21. Tennakone., K., Senadheera, G.K.R., de silva, D.B.R.A., Kottagode, I.R.M., 2000. Higly Stable Solid- State Solar Cell with the semiconductor 4 CuBr3S(C_4H_9)$_2$ as the hale collector. Applied Physics Letters, American Institute of Physics, Vol.77, No.13.

22. Kumara, G.R.R.A, Konna, A., Senadheera, G.K.R., Jayaweera, P.V.V., de Silva, D.B.R.A., Tennakone, K., 2000. Dye-sensitized solar cells with the hole collector P-Cu SCN deposited from a solution in n-propyl sulphide. Solar Energy Materials & Solar Cells 69 (2001), 195-199.

23. Kumara, G.R.A., Konno, A., Tennakone, K., 2000. Photoelectrochemical cells made from SnO_2/ ZnO film sensitized with Eosin Dyes. The Chemical Society of Japan, Chemistry letters 2001, CL-001086.

24. Kumara, G.R.R.A., Tennakone, K., Perera, V.P.S., Konno., 2000. Suppression of recombination in a Dye sensitized photo electrochemical cell made from a film of Tin IV oxide crystallites coated with a thin layer of Aluminum oxide. Institute of Physics, Journal of Physics D (Applied Physics) 34 (2001) 864-873.

25. Tennakone, K., 2000. Dye sensitized solar cells: New ideas for their improvement. Proceedings of 5th workshop on low cost electronic materials, Solar Cells and Renewable Energy Sources, Colombo 22-25: Feb 2000: 78-80.

26. Senadheera, G.K.R., Tennakone, K., 2000. Fabrication of solid state dye sensitized TiO_2 photovoltaic cells with CuCNS. Proceeding of 5^{th} workshop on Low Cost Electronic Materials, Solar Cells and Renewable Energy Sources, Colombo. 22-25, Feb 2000: 81-85.

27. Kumara, G.R.A., Konno. A., Shiratsuchi. K., Tsukahara, T., Tennakone, K., 2001. Dye-Sensitized Solar State Solar Cells: Use of crystal growth Inhibitors for deposition of the Hole Collector. American Chemical Society, Chem. Mater 2002, 14, 954 – 955.

28. Senadhera,,G.K.R., Jayaweera, P.V.V., Perera, V.P.S., Tennakone, K., 2001. Solid State dye sensitized photocell based on pentacene as a hole collector. Solid Energy Material & Solar Cells, 73 (2002), 103-108.

29. Tennakone, K., Bandara, J. Bandaranayake, P.K.M., Kumara, G.R.A., Konno, A., 2001. Enhanced Efficiency of a Dye Sensitized Solar Cell made from MgO coated NanocrystallineSnO_2. Japan Society of Applied Physics, Vol.40 (2001), PP.L 732-734.

30. Tennakone, K., Senadheera, G.K.R., Jayaweera, P.V.V., 2001. Enhancement of the energy and quantum conversion efficiencies of a photo electrochemical cell sensitized with a combination of cationic and anionic dyes. Current Science, Vol. 81, No.1.

31. Tennakone, K., Perera, V.P.S., Kottegoda, I.R.M. de Silva, L.A.A., Kumara, G.R.R.A., 2001. Dye-Sensitized Photovoltaic Cells: Suppression of Electron – Hole Recombination by deposition of the Dye on Thin Emulating Films, Journal of Electronic Materials, Vol.30, No.8.

32. Bandara, J., Tennakone, K., Binduhewa, P., 2001. Probing the tunneling of electrons from SnO_2 to Zno in dye-sensitization of composite SnO_2/ZnO by use of generated H_2O_2 via reduction of O_2. Royal Society of Chemistry, U.K., Journal of Chemistry, 2001, 25, 1303 – 1305.

33. Bandara, J., Tennakone, K., Kiwi, J., 2001. Surface mechanism of Molecular Recognition between Amuirophenols and Iron oxide surfaces. American Chemical Society. U.S.A., Langmuir 2001, 3964 – 3965.

34. Bandara, J., Tennakone, K. 2001. Interparticle charge transfer in Dye-Sensitized Film composed of two kinds of semiconductor crystalline. Journal of Colloidal & Interface Science 236, 375-378.

35. Jayaweera, P.M. Palayangoda, S.S., Tennakone, K., 2001.,NanoporousTiO_2 Solar Cells Sensitized with bromopyrogallol red ligands. Journal of Photochemistry & Photobiology A: Chemistry 140 (2001), 173-177.

36. Kumara, G.R.A., Kaneko, S., Okuya, M., Tennakone, K., 2002. Fabrication of Dye-Sensitized Solar Cells using Triethylamine, Hydrothiocynate as a Cu I crystal growth inhibitor. Langmuir 2002, 18, 10493 – 10495.

37. Jayaweera, P.M., Palayangoda, S.S, Tennakone, K., Gamage, R.G.C.R., 2002. Cobolt (11) - bis (1, 10 – Phenanthroline) triphenyl methane dye complexes and their photo sensitization properties in nonoporous photovoltaic devices. Current Science Vol.83.,No.11.

38. Tennakone, K., Jayaweera, P.V.V., Bandara, P.K.M., 2002. Dye-Sensitized photo – electrochemical and solid state solar cells: Charge separation, transport and recombination, mechanism. Journal of Photochemistry & Photobiology, 158 (2003), 125-130.

39. Bandara, J. Tennakone, K., Jayathilake, P.P.B., 2002. Composite Tin and Zinc oxide nano crystalline particles for enhanced charge separation in sensitized degradation of dyes. Chromospheres 49 (2002), 439-445.

40. Bandara, P.K.M., Jayaweera, P.V.V., Tennakone, K., 2002. Dye-sensitization of Magnesium oxide coated cadmium sulphide. Solar Energy Materials and Solar Cells, 2002, Solmat : 298, 1-8.

41. Tennakone, K., Bandaranaayke, P.K.M., Jayaweera, P.V.V., Konno, A., Kumara, G,R.R.A., 2002. Die-Sensitized composite Semiconductor nanostructures. Physics E 14 (2002) 190 – 196.

42. Kumara, G.R.A., Kaneko. S, Okiya, M., Konno, A., Tennakone, K., 2002. NonocrystallineTiO_2 film for Dye-Sensitized Solar Solid State Cells. Publication of Chemical Society of Japan, Key Engineering Materials Vol.228 – 229 (2002), 119 – 124.

43. Tennakone, K., 2002. Dye-Sensitized semiconductor nanostructures for solar energy conversion. Ceylon Journal of Science 9(1), 1-8 (2002).

44. Perera, S., Senadheera, G.K.R., Tennakone, K., 2002. The Effect of MgO on the Enhancement of the Efficiency in Solid State Die-Sensitized Photocells Fabricated with SnO_2 and Cul. The Chemical Society of Japan, 76, 659 – 662 (2003).

45. Tennakone, K., 2002. Dye sensitized semiconductor nanostructures for solar energy conversion. Ceylon Journal of Science (Physical Science). 9 (1) : 1 – 8.

46. Jayaweera, P.M., Kumarasinge, A.R., Tennakone, K., 2002. NanoporousTiO_2 photovoltaic triphenylmethane dyes. Journal of Photochemistry and Photobiology A: Chemistry 126:111 – 115.

47. Perera, V.P.S., Tennakone, K., 2003. Surface trop mediated recombination in dye sensitized solid state solar cell with CuI as the hole collector. Proceedings of the 19th Technical Session March 2003. Institute of Physics. 51-57.

48. Perera, V.P.S., Tennakone, K., 2003. Recombination processes in Dye-Sensitized Solid State Solar Cells with Cu I as the hole collector. Solar Enegry Materials & Solar Cells. 79 (2003), 249 – 255.

49. Perera, V.P.S., Senadheera, G.K.R., Tennakone, K., 2003. Sensitization of Aluminum Chloride adsorbed Tin (IV) oxide nanocrystalline film with Rose Bengal. Journal of Colloidal and Interface Science 265 (2003). 428-431.

50. Tennakone, K., Jayaweera, P.V.V., 2003. Depleted semiconductor Quantum Naowire in a electrolytic medium. Superlattices and Microstructures 33 (2003) 23-28.

51. Perera, V.P.S., Pitigale, P.K.D.P., Jayaweera, P.V.V. Bandaranayeke, K.M.P., Tennakone, 2003. Dye Sensitized Solid State Photovoltaic Cells based on dye mutilayer semiconductor nanostructures. American Chemical Society Journal of Physical Chemistry, B 2003, 107, 13758 – 13761.

52. Bandara, J. Disaratne, C.M., Nanayakkara, S.D., 2003. Fabrication of n-p junction electrodes made of n-type SnO_2 and P-type NiO_2 for control of charge recombination in DSSC's. Solar Energy Materials & Solar Cells, Science Direct 81 (2004), 429 – 437.

53. Perera, V.P.S., Jayaweera, P.V.V., Pitigale, P.K.D.D.P., Bandaranayake, P.K.M., Hasting, G., Perera, A.G.V., Tennakone, K., 2003. Construction of Photovoltaic device by deposition of thin film of conducting polymer polythiocyanogens. Science Direct, Synthetic Metal 143 (2004), 283-287.

54. Pitigala, P.K.D.D.P., Seneviratne, M.K.I., Perera, V.P.S., Tennakone, K., 2004. Sensitization of nanostructured TiO_2 by Electrostatic coupling of Ionic Dyes to Ionic Absorbents. American Chemical Society, Langmuir 2004, 20, 5100-5103.

55. Bandaranayake, K.M.P., Senavirathne, M.K.I., Weligamuwa.,P.M.G.M., Tennakone, K., 2004. Dye-Sensitized Solar Cells made from TiO_2 film coated with outer layers of different oxide materials. Science Direct, Solar Energy Materials & Solar Cells 85 (2005), 91-98.

56. Perera, V.P.S., Pitigale, P.K.D., Seneviratne, M.K.S., 2004. A solar cell sensitized with three different dyes. Science Direct, Solar Energy Materials & Solar Cells 85 (2005), 91-98.

57. Konno, A., Kittagawa, T., Kida, H., Kumara, G.R.A., Tennakone, K., 2004. The effect of particle size and conductivity of Cu I layer on the performance of solid state DSSC's. Science Direct, Current Applied Physics 3 (2005) 149-151.

58. Seneviratne, M.K.I., Pitigala, P.K.D.D.P., Perera, V.P.S., Tennakone, K., 2004. American Chemical Society, Langmuir 205, 21, 2997-3001.

59. Kumara, G.R.A., 2004. Dye sensitized solid state solar cell made from Magnesium oxide coated nanocrystallineTiO_2 films: Enhancement of Efficiency. Journal of Photochemistry and Photobiology A: Chemistry, MFN 4195, 164, 183.

60. Bandara, J., Jayasundera, A., 2005. Solid State dye sensitized solar cell with P-type NiO as a hole collector. Solar Energy Materials and Solar Cells, 85 (3), 385 – 390.

61. Jayaweera, P.V.V., Pitigala, P.K.D.P., Tennakone, K., 2005. Dye sensitized rear infrared room temperature photovoltaic photon detectors. Applied Physics Letters 85 (3), 5754-5756.

62. Bandara, J., Jayasundera, A., Weerasinghe, H.C., 2005. Enhancement of photovoltage of dye sensitized solar cells by introducing high band gap oxide layers. Solar Energy Materials and Solar Cells 85 (4), 341-350.

63. Senadheera, G.K.R., Kitamura, T., Wade, Y., Yanagida, S., 2005. Photosensitized of nanocrystallineTiO_2 film by a polymer with two carboxylic groups, poly2 – thiopheremalonic acid. Solar Energy Materials and Solar Cells, 88(3), 315-322.

64. Bandara, J., Pradeep, V.W., Bandara, R.G.S.T., 2005. The role of n-p junction electrodes inminimizing the charge recombination and enhancement of photocurrent and photovoltage in dye sensitized solar cells. Journal of Photovoltage in dye sensitized solar cells. Journal of photo chemistry and Photobiology A: Chemistry, 170(3), 273-278.

65. Senadheera, G.K.R., Kobayashi, S., Kitamura, J., Wade, Y., Yangida, S., 2005. Versatile preparation method for mesoporousTiO_2 electrodes suitable for solid state dye sensitized photo cells. Bulletin of Material Science MFN 5149.

66. Kumara, G.R.R.A., Kawaguchi, T., Katoh, Y., Tennakone, K., 2005. Dye sensitized solid state cells sensitized with Coumarinderivaties Pacific Chemistry Congress, Honululu, Hawaii, U.S.A., 15-20 Dec 2005, MFN 5523.

67. Kumara, G.R.A., Koneko, S., Konno, A., Okya, M., Murakam, K., Tennakone, K., 2006. Large area dye sensitized solar cells :Meterial aspects of fabrication. 14(7), 643-651.

68. Kumara, G.R.A., Okye, M., Konno, A., Tennakone, K., 2006. Shinso Leaf pigment for dye sensitized solar solid state solar cells. 90 (9), 1220-1226.

69. Perera, V.P.S., Seneviratne, M.K.I., Pitigala, P.K.D.D.P., Tennakone, K., 2005. Doping of Cu SCN film for enhancement of conductivity : Application in solid state DSSC's. Science Direct, Solar Energy Materials & Solar Cells. 86 (2005), 443-450.

70. Kumara, G.R.A., Kanno, A., Okuyo, M., Tennakone, K., 2005. Dye-Sensitized Solar Cells with extremely thin liquid film as the Redox Electron Mediator. The Chemical Society of Japan, Chemistry letters, Vol. 34, No.4 (2005).

71. Dharmadasa, I.M., Robers, J.S., Hill, G., 2005. Third generation multi layer graded bandgap solar cells for achieving high conversion efficiencies: Experimental results. Science Direct, Solar Energy Materials & Solar Cells, 88 (2005) 413-422.

72. Agenman, B.O., Kaneko, S., Kumara, A., Okuya, M., Murakami, K., Konno, A., Tennakone, K., 2005. Sensitization of NanocrystallineSnO_2 Film with Indoline Dyes. Japanese Journal of Applied Physics, Vol.44, No.23, 2005, 731-733.

73. Jayaweera, P.M., Rajapakse, R.M.S.P., Tennakone, K., 2005.,TiO_2nanoporous photo electrochemical cells (PEC's) sensitized with mixed cationic/anionic dye systems : Role of the second cationic fluorescent dye on photocurrent enhancement. Science Direct, Chemical Physics Letters 412 (2005) 29-34.

74. Seneviratne, M.K.I., Pitigale, P.K.D.D.P., Tennakone, K., 2005., Chromospheres linked conducting polymers attached to semiconductor surfaces : A strategy for development of DSSC's. American Chemical Society, Journal of Physical Chemistry B, 2005, 109, 16030-16033.

75. Sirimanne, P.M., Seneviratne, I., Tennakone, K., 2005. An enhancement of photo properties of solid state TiO_2/dye/CuI type cells by coupling mercurochrome with natural juice extracted from pomegranate fruits. The Chemical Society of Japan, Chemistry Letters Vol.34, No.11.

76. I/F Novic and DSSC's. Tennakone, K., Jayaweera, P.V.V., Pitigala, P.K.D.D.P., Perera, A.G.I., Tennkone, K., 2005. Semiconductor Science & Technologies. 20 (2005), L1-L3.

77. Senadheera, G.K.R., Silva, N.S., 2006. Efficient Quasi Solid Solar Cells employing molten salt electrolyte. Sri Lanka Journal of Physics, Vol.7 (2006) 15-22.

78. Fernando, T.M.R.C., Senadheera, G.K.R., 2008, Synthetic and Characterization of carboxylatedthiophere co polymers and their photo-voltaic cells. Current Science Vol.95, No.6.

79. Fernando, J.M.R.C., Senadheera, G.K.R., 2008. Natural Anthrocyoni..as photosensitizes for DSSC's. Current Science Vol.95, No.5.

80. Bandara, J., Pradeep, U.W., 2008. Turning of flet band potentials of nanocrystallineTiO_2 and SnO_2 particles with an outer shell of MgO layer. MFN 5913, 517(2), 952 – 956.

81. Bandara, T.M.W.J., Dissanayake, M.A.K.L., 2008, Polyethylene oxide PEO – based anion conducting solid polymer electrolyte for PEC solar cells. Journal of Solid State Chemistry, 12(40003), 913-920.

82. Ariyasinghe, Y.P.Y.P., Wijayarathna, T.R.C.K., Kumra, I.G.C.K., Jayaratne, I.P.L.,Thotawatthage, C.A., Gunathilake, W.S.S., Senadheera, G.K.R., Perera, V.P.S., 19th October 2010. Efficient possivation of SnO_2nano crystallites by Indoline D-149 via dual chelation. Journal of Photochemistry & Photobiology A, Chemistry xxx (2010) xxx-xxx (Article in Press.)

83. Bandara,T.,Dissanayake,M.A.K.L.,Somasundaram, L.R.A.K.,Illeperuma,O.A.,Varaprathan, K.,Mellander, S.C., Postgraduate Institute of Science,University of Peradeniya, Peradeniya. 1994.
    a. Quasi Solid State DSSC's
    b. Solid State DSSC's.

84. Bandara, L.R.A.K., Dissanayake, M.A.K.L., Ekanayake, G.V.K., Illeperuma, O.A., Weeraman, T.T.K., Department of Chemistry, University of Peradeniya. 1998. Dye-Sensitized photoelectrochemical solar cells with PEO based solid polymer electrolytes. Proceedings of the workshop on renewable Energy Sources, Colombo 10-11 Feb. 1998, 11 PR 2937, 541.14: 541.13.

85. Fernando, C.A.N., Weththasinghe, S.K., Department of Physics, University of Ruhuna. 2000. Phtocurrent generation of a dye sensitized solid state photovoltaic cell made from n-Cu_2O and P – Cu SCN thin' film. Proceedings of the 5th Workshop on low cost Electronic Materials, Solar Cells and Renewable Energy Sources. Colombo, 22-25 Feb.2000: 86-93.

86. Fernando, C.A.N., Kumarawadu, I., Kiyagawa, A., Suzuki, M., Department of Physics, University of Ruhuna, Matara. 1999. Crystal Violet dye-sensitized photocurrent by participation of surface sates on P. Cu SCN photocathode. Solar Energy Materials. 629.7.064.535.215 semi conductor materials.

87. Fernando C.A.N., Weththasingha, S.K., Department of Physics, Ruhuna, Matara. 2001. Improved photocurrent quantum efficiency and kinetics of photocurrent generation of a dye sensitized solid state solar photovoltaic cell made from n Cu2O and P-Cu SCN thin film. Japanese Journal of Applied Physics. 40:1-7.

88. Fernando, C.A.N., Takashi, K., Kitagawa, A., Suzuki, M., Wethasinghe, M., Kunarawadu, I., Department of Physics, University of Ruhuna, Matara. 2001. Remarkable stability of the enhanced sharp photocurrent in netyhlinolet – C18 and Solar Energy Materials. 629.7. 064: 535.215.

89. Fernando, C.A.N., Kumarawadu. I., Department of Physics, University of Ruhuna, Matara. 2001. Colloidal P-CuI sensitized double dye system. Semiconductor Science and Technology: 214 – 218, PR 3905.

90. Fernando, C.A.N., Priyankara, W.TC.,Dharmadasa, I.M., Department of Physics University of Rhuna, Matara. 2002. Photocurrent of Ruhuna, Matara. 2003. Photocurrent enhancement of interlocked LB film dye layers in a P-Cu SCN sensitized photoelectrochemical cell. Renewable Energy. 25:69-79.

91. Fernando, C.A.N., Department of Physics, University of Ruhuna, Matara. 2002. Hydrogen production from photoelectrochemical cells using low cost semiconductor film, and dye sensitized solar cell production with ordered and disordered molecular arrangement.

92. Jayaweera, P.M., Department of Chemistry, University of Colombo, Colombo. 2003. Photocurrent conversation efficiency of solar cells sensitized with a combination of ationic and anionic materials.

93. Ravirajan, P., David, T.R., Department of Physics, University of Jaffna, Jaffna. 2005. Controlling recombination kinetics of hybrid, polymer/ metal oxide solar cells.

94. Premalal, E.V.A., Perera, V.P.S., Open University of Sri Lanka, Nugegoda. 2005. Photovoltaic effects of dye-deposited metal electrodes in electrolytic media. Proceedings of the 21st Technical Session – Institute of Physics, March 2005: 57-61.

95. Director, National Energy Research and Development (NERD) Centre, J-Ela. 2006. Cheaper ways to produce Dye-Sensitized Solar Cells.

96. Hussain, F.M., Sirakumar, V., Department of Physics, University of Peradeniya, Peradeniya. 2007. Structural studies of plant pigments used in dye sensitized solar cells. Proceedings of the University of Peradeniya Research Sessions ,Purse 2007. 12 (ii): 275 - 277. PR6160.

97. Bandara, T., Dissanayake, M., Illeperuma, O.A., Varaprathen, V., Vignarookan, K., Mellander, P.E., 2008. Postgraduate Institute of Science, University of Peradeniya, Peradeniya. Polyethylene oxide based anion conducting solid polymer electrolyte for PRC solar cells.

98. Siripala, W.P., University of Kelaniya, Kelaniya. 2008. Solid state dye sensitized solar cells.

99. Aponsu, G.L.M.P., De Silva, R.C.L., Perera, V.P.S., Open University of Sri Lanka, Nugegoda. 2008. Enhanced photovoltaic effects of dye sensitized solar cells of SnO_2surface modified with gold nanoparicles. PR 6207.

100. De Silva, R.C.L., Liyanage, L.S.G., Perera, V.P.S., Open University of Sri Lanka, Nugegoda. 2008. Electron Kinetics of Dye Sensitized Solar Cells made from Al_2O_3 coated SnO_2nano crystalline films. PR 6214.

101. Aponso, G.L.M.P., Premalal, E.V.A., Liyanage, L.S.G., Perera, V.P.S., Open University of Sri Lanka, Nugegoda. 2008. Deposition of P_t and An Quantum Dots on TiO_2 nanoparticles: study of ballistic electron transport with dye sensitization

102. Solar Electric Light Fund Report. 1991. Solar Power and light for Developing World.

103. Solar Electric Light Fund Report. 1991. Energy Environment and Economic Development.

104. Dharmadasa, I.M.2009. A Future Dominated by Solar Energy. Sheffield Hallan University, Sheffield, U.K.

105. Dharmadasa, I.M.2009. Solar Energy Technologies: A Status Report. Sheffield Hallan University, Sheffield, U.K.

106. Manil, G.Gap Analysis Product standards of Solar PV. Arizona State University, Arizona, U.S.A.

107. United States Department of Energy.2009. The Solar America Board for Codes and standards (Solar ABC) GAP Analysis process for Solar PV's.

108. Clacerie, A., ADME, France, Joyce, A, INETI Portugal, Rantil M., Formas, Sweden, Ahm, P.PA Energy, Denmark, Passiniemi, P., NAPS, Finland.2009. A SWOT Analysis of PV RTD in Europe.

109. Nanotechnology Developments in India – A status Report. April 2009.

110. Guo, Ying., Huang, Lu., Portar, Alan L., 2009. Profiling Research Patterns for a New and Emerging Science and Technology: Dye-Sensitized Solar Cells, Georgia Institute of Technology, Atlanta, U.S.A., sma.tech.edu/bitstream/handle/1853/3237/22-656-PB.pdf

111. Berger, Frank.,Loeffler, Jonathan., September 2005. SWOT Analysis concerning the use of Nanomaterials in the Solar Energy Sector.

112. Report from nanoform. Cum: Nanotechnology helps solve the world's energy problems – April 2004.

113. Report from VTT Technology Studies, Nano Road Map project October 2004.

Expert interview, Mr. Ken FraumhoflerISE Freiberg, Department of Solar Cells, Germany.

114. Dye-Sensitized Solar Cells, European Institute for Energy Research, 2005.23 April 2006<http:www.either.um_karlsrule_ de>

115. Gratzel, Michael, O'Regan Brian. 1991. A low cost, high efficiency solar cells based on Dye Sensitized colloidal Ti O_2 film, Institute of Technology CH1015, Lausane, Switzerland, Letters to Nature, Magazine, Nature 359 (737-740).

116. Campbell, R. Wayne.2007.taking Nature cue for cheap solar power, Massey University, Nanotechnology Research centre, New Zealand, Science Direct.

117. Bryan, R. 2008. A new ingredient for solar cells – Raspberries.

118. Amonbitbamy, V.2008.Die-Sensitized solar cells based on Titanium dioxide sensitized with natural dyes, Department of Physic and Integrated Nanotechnology Research centre, Faculty of Science, Khonikaen, University of KhaKha 4002, Thailand.

119. Gratzel, Michael.2005.Solar Energy Conversion by Dye-Sensitized Photovoltaic Cells, Inorganic Chemistry. Vol 44, P 6841-6851.

120. Botanical Names and Sinhala Names of Plants grown in Sri Lanka.

121. Kudagamage, Horticultural Crop Research & Development Institute, Gannoruwa, Sri Lanka.

122. Weerasinghe, A. Botany of Crop. Rajarata University, Sri Lanka.

123. Corkish, Richard. Solar Energy.2010. Australian Academy of Science, School of Photovoltaic & Renewable Energy, University of New South Wales, Sydney, Australia.

124. Graph of Best Research Cell Efficiencies on DSSC's from 1975 to 2010. National Renewable Energy Laboratory Boulder, Colorado, U.S.A.

125. Main Research Organizations and Established Companies in the world carrying out R & D on Dye-Sensitized solar cells. PV Industry Note # PV1-0302.01 8 August 2005. Prometheus Institute for sustainable Technologies, 1420 North Lake Shore Drive # 9A, Chicago, Illinois 60610, U.S.A.

126. Mukhergee. D andChackravathi. S : 'Fundamentals of Renewable Energy Systems', New Age International Ltd. Publishers, New Delhi, India, Reprint 2005.

127. Sawatsuk.T: 'Green Photosynthesis for Dye-sensitized Solar Cells', National Nanotechnology Center (NANOTEC) , NSTDA, 111 Thailand Science Park, Phathuthani 12120, Thailand, December 2008.

128. Chindaduang. A : 'Polymer Assisted Degeneration of Zinc Oxude for Dye-sensitized Solar Cells' National Nanotechnology Center, NSTDA, 111 Thailand Science Park, Phathuthari 12120, Thailand, December 2008.

129. Amonbitbamy. V : 'Dye-sensitized Solar Cells Based on Titanium Dioxide, sensitized with natural dyes', Department of Physics and Integrated Nanotechnology Research Center, Faculty of Science, Khonikaen University, Khan Khan 4002, Thailand, December 2008.

130. Ammsakihan.T : 'Development of Low Temperature Slurry' for Dye-sensitized Solar Cells Flexible Photo electrodes', Department of Chemistry and Center of Excellence for Innovations in Chemistry, Faculty of Science, Mahidol University, Rama 6 Road, Bangkok 10400, Thailand, December 2008.

131. Fernando.J.M.R.C. andSenadheera. G.K.R.:
Natural Anthrocyanins as Photosynthesis for Dye-sensitized Solar Devices', Institute of Fundamental Studies, Hantana Road, Kandy, Sri Lanka, Current Science Vol. 95, No.5, 10 September 2008.

132. Fernando. J.M.R.C. and Senadheera.G.K.R: 'Synthesis and Characterization of CarboxylatedThiophene Co-polymers and their use in Photovoltaic cells', Institute of Fundamental Studies, Hantana Road, Kandy, Sri Lanka, Current Science Vol. 95, No.6, 25 September 2008.

133. Kamat. Prashant, Professor : 'Meeting the Clean Energy Demand', University of Notre Dam, Department of Chemistry and Bio Chemistry, Indiana 46566 – 5674, U.S.A., Journal of Physics C 2001, 111, 2834 – 2800, 6 December 2006.

134. New Energy News: 'Planning Molecular Antennae to convert light photons to electrical power', <http:// www.podrak.com/ire/ine9.html>.

135. Exploring the Nanowaorld : <http:// mrsec.misc.edu /edate/index.html>.

136. Yamazoki.E and Murayama. M: ‘Utilisation of Natural Carotenids as Photosynthesizers for Dye-Sensitized Solar Cells,' Industrial Research Division, Prefectural Science and Technology Promotion Center, Takachaya 5-5-45, Japan, Science Direct, 3 August 2006.

137. Hitoshi. K and Hideki. S : ‘Theoritical Studies of 1:1 Charge Transfer complexes between Nitrogen containing Heterocycles and I_2 Molecules and Implications on the, Performance of Dye-Sensitized Solar Cells’, Energy Technology Research Institute, National Institute of Advanced Science and Technology (AIST), Tsukuba Central 5-1-1, Higashi, Tsukube, Japan, Science Direct, 5 December 2005.

138. Kazuliom. S, Yamaguoh. M, Kumagen. M., Tanabo N, Yonagid, S: 'Dye-Sensitized Solar Cells with Ionic gel electrolyte prepared from Imidazcilian Salts and Agarose', Photonics and Materials Research Department, Institute of Research and Innovation, 1201 Takode, Kashima, Chibo 227-0861, Japan, Science Direct, 14 April 2005.

139. Perera. V.P.S., Pitigala. P.K.D.D.P., Seneviratne. M.K.I, Tennakone, K: 'A Solar Cell sensitized with three different dyes', Institute of Fundamental Studies, Hantana Road, Kandy, Sri Lanka, Science Direct, 2 June 2004.

140. Seneviratne. M.K.I, Pitigala. P.K.D.D.P., Perera. V.P.S., Tennakone. K : ‘Molecular Rectification: Applications in Dye-Sensitized Solar Cells’, Institute of Fundamental Studies, Hantana Road, Kandy, Sri Lanka, 9 December 2004.

141. Garcia C.G., Polo. A.S., IheN.Y.M.: 'Fruit Extracts and RuthaniumPolypryndime Dyes for sensitizations of TiO_2 in Photoelectrochemical Solar Cells', Institute of Fundamental Studies, Hantana Road, Kandy, Sri Lanka, Science Direct, Journal of Photo Chemistry, 10 April 2003.

142. Battacharya. K.G., Sarme. A : ‘Adsorption characteristics of the Dye Brilliant Green on Neem Leaf Powder’, Department of Chemistry, Gauchati University, Gawachati 781014, Assam, India, Science Direct- Dyes & Polymers, 6 January 2003.

143. Chigurupati. N, Saiki. L, Gayser. C., Dash A.K: 'Evaluation of Red Cabbage Dye as a potential natural colour for, pharmaceutical use', Department of Pharmacy, Sciences, School of Pharmacy and Allied Health Professions, Craghtm University 2800, California Plaza, Omaha NE6878, U.S.A., International Journal of Pharmeceutics, 30 April 2002.

144. Tennakone. K, KuroG.R.R.A., Kottegoda. RM, Perera. V.P.S. WeerasundaraP.S.R.S.: ‘Sensitization of Nanoporous films of TiO_2 with Santalin (Red Sandlewood pigment) and construction of Dye-Sensitized Photovoltaic Cells’, Institute of Fundamental studies, Hantana Road, Kandy, Sri Lanka, Science Direct, Journal of Photo Chemistry and Photo Biology, 9 June 1998.

145. PVNET European Roadmap for PV R & D, AmulfJager – Walden Office for Publications of the European Union 2004.

146. Nanocrystalline Dye–Sensitized Solar Cell Kit. http://www.solidem. com/solarcell/ cellkit.html.

147. National Renewable Energy Laboratories (NREL), Colorodo, U.S.A., Feature Storage-Photovoltaic Innovations, Win 2 R & D 100 Awards.

148. Luguear. Antonio : 'Handbook of Photovoltaic Science & Engineering', John Wiley and Sons, ISBN 0471491969.

149. Cheng Hsiao Wu, Williams Richard: 'Limiting efficiencies of multiple energy - gap quantum devices', Journal of Applied Physics, U.S.A., 54-674(1983).

150. ASTM International G173-03, 'Standard Tables for Reference, Solar Spectral Irradices.'

151. Winfel Peter (2005): 'Physics of Solar Cells' Weinheim. Wiley-VCH, ISBN 3-527-40438.

152. Green. D, Martin A : 'Third generation photovoltaics – Solar Cells for 2020 and beyond.'

153. Solar Cells: Wikipedia, 25 April 2006 ,<http;//ea.wikipedia. org/wiki.solar.cell>.

154. LovgreStephen : 'Spray-on Solar Power Cells are true break throughs', National Geographic News, 14 January 2005, 18 April 2006, <http://news. nationalgeographic.com>.

155. Gratzel. Michael: 'Solar Cells for cheap – 2006', Interview with the Inventor of DSSC'sPolytechniquesFederales de Lausame, Switzerland at MIT Technology Review, 12 September 2006 , http://www.technologyreview.com/read–article.aspx? id = 17490&ch = biztech&sc=&pg=1.

156. Bryan R : 'A new ingredient for solar cells – Raspberries', 9 January 2008.

157. Campbell R. Wayne Dr: 'Taking Nature's cue for Cheap Solar Power,' Massey University, Nanotechnology Research Centre, New Zealand, Science Direct, 6 April 2007.

158. LenzmanF.O., Kroon J.M.: 'Recent Advances in Dye-sensitized Solar Cells', Energy Research Centre of Netherlands(ECN), Westerduinweg 3, Petten 1725, Netherlands, 13 September 2008.

159. Huijser, AnmarieDr: 'Around the world with Dye-Sensitized Solar Cells' Technical University of Delft, Netherlands, 27 May 2008.

160. TakenakaK : 'SONY develops cost – efficient Solar Cells', SONY Corporation, Tokyo, Japan, 25 May 2008.

161. Solaronix S.A., Rue de Louriette 129 CH-1170, Anborne, Switzerland, 'Dye Solar Cell Assembly Instructions.'

162. Wan H: 'Dye-Sensitized Solar Cells', Department of Chemistry, University of Alabama, Alabama,U.S.A.

163. University of Karlsruhe, European Institute for Energy Research: 'Dye- Sensitized vs Thin Film Solar Cells', 30 June 2006.

164. Gratzel Michael, O'Regan Brian: 'A Low cost, High efficiency Solar Cells based on Dye – Sensitized colloidal TiO_2 films', Institute of Physical Chemistry, Swiss Federal Institute of Technology CH1015, Lousane, Switzerland, Letters to Nature Magazine, Nature 359 (737-740) 24 October 1991.

165.. CherepyN.J, SmestadG.P., Gratzel Michael, ZhonyJ.N: 'Ultra Fast Electron Injection Implications for a Pphotoelectrochemical Cell utilizing an Anthrocyanin Dye Sensitized TiO_2Nanocrystalline Electrodes' Department of Chemistry, University of California, Santa Cruz, California 95064, U.S.A., Journal of Physics B1897, 101-9342-9342-9351, 7 September 1997.

166. GratzelMichael : 'Photoelectrochemical Cells' , Nature, Volume 414, 15 November 2001.

167. GratzelMichael : 'Solar Energy Conversion by Dye – Sensitized Photovoltaic Cells', Inorganic Chemistry, 2005 Vol. 44, p6841-6851.

168. GratzelMichael : 'A high molar Extintion coefficient charge transfer sensitizer and its implications in Dye-Sensitized Solar Cells', Journal of Photochemistry and Photobiology 185, 28 June 2006.

169. RossierI.N. GratzelMichael : 'Solid Hybrid Dye – Sensitized Solar Cells – New Organic Materials, Charge recombination and stability', EcolePolytechniqueFederale Lausanne, Switzerland, 5 February 2009.

170. Kruger J : 'Interface Engineering in solid state Dye – Sensitized Solar Cells', EcolePolytechniqueFederale , Lausanne, Switzerland, 2003.

171. Gratzel Michael, Kalyanasunderam K: 'Dye-Sensitized Cells (DYSC) based on Nano crystalline Oxide semiconductor Films', Laboratory for Photonic's and Interfaces, Swiss Federale Institute of Technology, CH 1015, Lausanne, Switzerland, 2 February 1997.

172. TennakoneK : 'Dye-Sensitized Semiconductor Nanostructures for Solar Energy Conversion', Institute of Fundamental Studies, Hantana Road, Kandy, Sri Lanka, Ceylon Journal of Science.

173. SenadheeraG.K.R., JayasuriyaP.V.V., PereraV.P.S. Tennakone K: 'Solid State Dye-Sensitized Photocell based on Pentacene as a hole collector', Institute of Fundamental Studies, Hantana Road, Kandy, Sri Lanka, Solar Energy Material and Solar Cells Journal 73 (2002) 103-108, 8 October 2001.

174. SubramniamV.R.: 'Nanostructured Semiconductor components for Solar Cells', Department of Chemical and Materials Engineering, University of Navada, Navada, Reno, U.S.A., Electro Chemical Society Interface Journal, Science Direct, 2007.

175. Dye-Sensitized Solar Cells, European Institute for Energy Research, 2005. 23, April 2006 <http://www.either.um-kalsruhe-deEl-Agez, T.M.Tayayan, A.E., Al-Kalour, A., Jaya, S.A., Abdel Latif, M.S. Dye Sensitized Solar Cells Based on ZnO Film and Natural Dye. Internation Journal of Materials and Chemistry. 2012. Vol.3, pp 105-110.

176. Calogero, G. DiMarco, G., Caramon, S. Cazzanti, S and Argazzi and Bignozzi, C.A. Natural dye sensitizers for photoelectrochemical cells, Energy & Environment Science, 2009, Vol.2, pp1162-1172.

177. Moon, J., Tuominen, A., and Suominen, A. Forecasting a change in technology: Are Dye-sensitized solar cells a source of ubiquitos energy? International Journal of Technology, Policy Management, Vol.12, Nos 2/3, 20/2, pp 177-194.

178. Zhon, H. Wu L., GaO, Y. and Ma, T. Dye sensitised solar cells using 20 natural dyes as sensitizers. Journal of Photochemistry and Photobiology A. Chemistry 2011,pp 188-194.

179. Narayan, R.M., Review: Dye sensitized solar cells based on natural photosensitizers. Renewable and Sustainable Energy Reviews 16 (2012), pp208-215.

180. Buraidah, M. H., Teo, L.P., Yusuf S.N.F., Noor, M.M., M.Z., Careem, M.A., Majid, S.R., and Araf, A.K. TiO2/Chitosan – NH4I (+I2)-BMII-Based Dye-Sensitized Solar Cells with Anthrocyanin Dyes Extracted from Black Rice and Red Gabbage. International Journal of Photoenergy Vo.2011 (2011), pp1-9.

181. Nuwanya, A.C., Ezeno, F.I., and Ejikme, P.M. Dye Sensitized Solar Cells: A technically and economically alternative concept to p-n junction photovoltaic devices. International Journal of Physical Sciences, 2011, Vol.6 (22), PP 5190-5201.

182. Hardin, B.E., Snaith, H.J. and McGhee, M.D. The renaissance of dye sensitized solar cells. Nature Phototonics 2012 Vol., pp162-169.

183. El-Agez, T.M., Tayyan, A.E., Al-Kalaur, A., Jaya, S.A., Abdel Latig, M.S. Dye Sensitized Solar Cells Based on ZnO Films and Natural Dyes. International Journal of Materials and Chemistry. 2012 Voll.3, pp105 – 110.

184 Harrey, J.P., Toan, S., and Rochford, J.Artificial Photosynthesis: A workshop in Solar Cell Design. Department of Chemistry, University of Manachusetts, Boston, U.S.A. 2011, pp 1-6.

185. Dumbrava, A., Enoche, I., Opera, C.I., and Georgexn Towards a more efficient utilization of Betalians as pigments for Dye-Sensitized Solar Cells. Digest Tournal of Nanomaterials and Biostructures.. 2012. Vol.7, No.1, pp 339-351.

186. Cruz, R., Alfredo, D., Tanaka, P., and Mendes, A. Reduced graphene oxide films as transparent counter -electrodes for dye sensitized solar cells ,Science Direct, Elsevier, Solar Energy, 2011. Vol. 86, pp 716 - 724.

187. Chen, C., Long, M., Xia, Min., Zhang, C., and Cai, W. Raduction of graphene oxide by an in-site photoelectro chemical method in a dye sensitized solar cell assembly.

Springer Open, Nanoscale Research Letters. 2012 .Vol.7(1):101, pp 1-5.

188 De Silvestro, H., What physical Factors Affect Current - Voltage Characterisitcs of Dye Solar Cells? Chief Scientist Dyesol Ltd., New South Wales, Queensburg Australia. 2008. Dyesol Newsletter, February 2008. pp 1-16.

189. Gordon, R.G. Criteria for choosing Transparent Conductors. www.mrs. org/publications/bulletin, Augst 2000. 20000. pp52-57.

190. Halme, J., Toivola, M.Tolvanen, A., and Lund, P. Charge transfer resistance of spray deposited and compressed counter electrodes for dye-sensitized solar cells on plastic substrates. Elsevier, Science Direct, Solar Energy Materials & Solar Cells. 2006. Vol.90, pp 872 -886.

191. Fleischer, K., Area, E., and shvets, I.V.Alternative Flourine Precursor for synthesis of SnO2: F by spray pyrolysis. Thin Solid Films. Cleaner Energy Laboratory, School of Physics, Trinity College Dublin, Dublin , Ireland. 2011. pp 1-23.

192. Hirunlabh, J., Suthateetanet, S. Kirtikara, K., and Pyrn, R. D. School of Energy & Materials, King Mongbut; Univeristy of Technology, Bangkok, Thailand. DSSC's with natural dyes.Thammasat International J.Sc. Tech. Vol 3 Nos, 1998. pp 10-20.

193. Stathatos, E., and Dionysion, D.D. Comparative Studies on Dye Sensitized Solar Cells with nanostructured TiO2 film prepared inroom or in high temperature. Technological Educational Institute of Patras, Greece. 2009. pp 1-4.

194. Yousaf, S.A., and Ali, S. Effect of Flourine doping an Optoelectronic properties of Tin dioxide. Department of Physics University of Lahore, Pakistan. 2008. Coden-JNSMAC PK ISSN 0022-2941,Vol.. 48,No.1 & 2, PP 43-50.

195. Zhang , Q., and Cad, G. Nanostructured photoelectrodes fo dye-sensitized solar cells. 2011. Elsevier, Science Direct, Nanotoday, Vol,6, pp 91-109.

196. Mertinson, A.B.F., McGrarrah, J.E., Parpia, M.O.K., and Hupp, J.T.Dynamics of charge transport and recombinationin ZnO nanorod array dye-sensitized solar cells. Physical Chemistry Chemical Physics. Journal. 2006.pp 4655 -4659.

197. Senadhera, G.K.R.. Spray painted nanostructured TiO2 electrodes for solid-state dye sensitized photocells. Sri Lanka Journal of Physics, Institute of Physics, Sri Lanka. 2004. Vol.5, pp 17-25.

198. Gratzel, M., and Durrant, J.R.Dye-Sensitized Mesoscopic Solar Cells. Chapter 8.2008. pp 503-536.

199. National Solar Technology Roadmap. National Renewable Energy Laboratory, Colorado, U.S.A. Sandia National Laboratories, U.S.A, and U.S. Department of Energy. 2007. NREL/MP 520-41739.

200. Durr, M., Schmid, A., Obermeuier, M., Rosselli, S., Yasuda, A., and Nelles. Low temperature fabrication of dye-sensitized solar cells by transfer of composite porous layer. Nature Materials 2005. Vol.4, pp 607-611.

201. Li, N., Pan, N., Li, D., and Lin, S. Natural Dye-Sensitized Solar Cells based on highly ordered TiO2 Nanotube Arrays. International Journal of Photoenergy. 2013. Vol. 2013, 5 pages.

202. Nishantha, M.R., Yapa, Y.P.Y.P., and Perera, V.P.S. Sensitization of Photoelectrochemical. Solar Cells with a natural dye extracted from Kopsia flavida fruit. Proceedings of Technical Sessions, Institute of Physics, Sri Lanka. Department of Physics, Open University of Sri Lanka. 2012. Vol.28, pp 54-58.

203. Kelvin, O.O., and Ekpunobi. Fabrication and characterisitcs of Dye Sensitized Solar Cell using Anarcardium Occidentale Sensitizer. Advances in Applied Science Research. Department of Physics, Nmamdi Azikriwe University , Nigeria. 2012. Vol.3(5), pp 3390 - 3395.

204. Moustofa, K.F., Tekaby, M.Shenany, E.T., and Khattab, N.M.Green Dyes as Photosensitizers for Dye-Sensitized Solar Cells. Solar Energy Department, National Reserch Centre, Dokki, Giza , Egypt. Journal of Applied Sciences Research 2012. Vol.8(8), pp 4393-4404.

205. Lai, W.H., S.Y.H., Teoh, L.G., and Hon, M.H.Commercial and natural dyes and photosensitizers for a water - based dye sensitized solar cell loaded with gold particles. Department of Materials Science and Engineering National Cheng kung University, Tainan, Taiwan. Science Direct. Journal of Photochemistry and Photobiology Chemistry. 2005. Vol 195, pp307-313.

206. Cramer , H.E., Griep, M.H.., Choi, D.S., and Kama, S.P. Green Nanochemistry Approach to Titanium Dioxide nanoparticle Dye-Sensitized Solar Cells. United States of America, Army Research Laboratory, Aberdeen Proving Ground, Maryland, U.S.A. 2012. ARL-TR-6033, 22 pages.

207. Mamide, T., Mandhe, S.B., and Mishra, A. Study and Analysis of Dye -Sensitized Solar Cells. Department of Mechanical Engineering, M.B.E.Society College of Engineering, Nagpur, India. International Journal of Modern Engineering Research, Vol. 2, Issue 5. 2012. PP 3597 - 3601.

208. Chen, Y.S., Lee, J.N., Tsai, S.Y., and Ting, C,C, Manufacture of Dye, Sensitized Nano Solar Cells and their I - V Curve Measurements. Institute of Mechatronic Engineering, National Taipei University of Technology, Taiwan. Proceedings of ICAM 2007. 2007. 7 pages.

209. Puspa, S. Natural Dye Sensitized Solar Cells - A Review. Ingertaconnect, Publishing Technology, Advanced Science Letters. 2012.pp1- 10.

210. Narayen, M.R. Investigation of some common Fijian flower dyes as photosensitizers for dye sensitized solar cells. School of Engineering and Information Technology, Charles Darwin University, Darwin, Australia. Renewable and Sustainable Energy Reviews. 2012. Vol.16,pp 208 - 215.

211. Alhamed, M., Issa, A.S., and Doubal W. Studying of Natural Dyes properties as photosensitizer for Dye Sensitized Solar Cells (DSSC). Department of Physics, Faculty of Sciences, Alleppo University, Syria. 2012. Journal of Electron Devices, Vol. 16, pp1370-1383.

212. Nataraj , N.M. A Comparative Study of the Photovoltaic Response of Anthrocyanin Dyes from Different Natural Sources. United States Army Research Laboratory, Composites and Hybvrid Materials Branch. 2012. pp1-17.

213. Kumara, N.T.R.N.Ekanayake, P., Lim, a., Liew, L.Y.C., Iskonder, M., Ming, L.C., Senadheera, G.K.R. Layered Co-sensitization for enhancement of conversion efficiency of natural dye sensitized solar cells. Faculty of Science, University of Brunei, Bovneo and Institute of Fundamental Studies, Hantana Road, Kandy, Sri Lanka. 2013. Journal of Alloys and Compounds 581 (2013 186-191.

214 US State Market Insight, Quarterly Publication (Q2 – 2013) of GTM Research & Solar EnergyIndustries Association (SEIA), U.S.A

215 Huizhi Zhou, Liqiong Wu, Yurong Gao , Tingli Ma . Dye – Sensitized Solar Clls using 20 Natural Dyes as Sensitizers . School of Chemical Engineering , Dahlian

216. MonishkaRita Narayan. Review : Dye-Sensitized Solar Cells based on natural photosensitizers .School of Engineering and Information Technology , Faculty of Engineering , Technology ,Science and environment , Charles Darwin University , Darwin , Australia . 2012. Renewable and Sustainable Energy Reviews. 16, (2012), 208 – 215 .

217. Yiming , Chen., Haiyan ,Zhang., Yuting, Chen., and Jaiapeng, Lin. Study of Carbon Nanocomposite Counter Electrodes for DSSC's , Faculty of Materials 7 Energy , Guandang University of Technology , Guanzhou , China. Journal of Nanomaterials . 2013. 6 pages .

218. Huang, S., Moon, J., Lee, S., Kim,D.H., Lee, D., Choi,W., and Jeon, M. Carbojn Nanotubes as Counter electrodes for DSSC's , Department of Nanosystem Engineering , Inje University ,Gimhoe,Gyeongnam , South Korea . 2007 . Electronics Letters , Vol. 43, No. 25,2 pages.

219. Photovoltaics : Thin Film Technology about to make it's breakthrough . Solar Server .2008.

220. Grama,S. A Survey of Thin Film Solar Vopltaic Industry and Technologies . Massechusettes Institute of Technology , Massechsettes , U.S. A. 2008 .

221. Green, M.A. Recent Developments in Photovoltaics .Solar Energy Vol. 76, No. 1 – 3 , 3 – 8 . 2004 .

222. Chopra, K.L., Paulson, P.D., and Dutta, V. Thin Film Solar Cells an Overview . progress in Photovoltaics Research and Applications . Vol. 12, No. 2 – 3 . 2004, pp 69 -- 92.

223. Cadmium telluride Solar Cells . Encyclopedia Britanica Inc, U.K. 2014.

224. Cadmium telluride (Cd te) Photovoltaics .What Is .com . 2014.

225. Pontmons, J., and Von Roederm , B. Thin Film CIGS and Cd Te Photovoltaic Technologies :Comercializat6ion , Critical Issues and Applications . Vol. 14 , No. 5. 2006. Pp 393 – 411 .

226. Stamberg, B.J. Copper indium gallium selenide and related materials for Photovoltaic Devices . A Critical Review in Solid State and Materials Science , Vol. 27 (2) : 73 . 2002 .

227 Charaacterization of Efficient CIGS Absorbers . National Renewable Energy Laboratory, Boulder , Colorado, U.S.A. May 2008.

228. Jorgenson, M.C., Norrman, K., and Knebas, F.C. Stability / Degradation of Polymer Solar Cells . Solar Energy Materials & Solar Cells .2008. Vol. 92, (7), 686.

229. Sharker, M.C., Muhlbacher , D., Koppe , M., Waluf, C. Design Rules inj Bulk Heterojunction Polymer Solar Cells . Advanced Materials . 2006. Vol. 18 (6), 789.

230. Heywang, W., and Zainger , K.H. Silicon the Semiconductor Material . Springer verlog 2004.

231. Whenham, S.R., Green, M.A., Watt, M.E., Corkish, R. Applied Photovoltaics . Earthscan . 2007. Chapter 2.

232. Polycrystalline Thin Film Solar Cell Technologies . National Renewable Energy Laboratory , Boulder, Colorado, U.S.A. 10 February 2011.

233. Nakayashiki, K., Rawanville , B., Yelundur , V., and Hanoko , J,I. Fabrication and Analysis of High efficienjcy String Ribbon Silicon Solar Cells . Solid State Electronics . 2006. Vol.50, 1406.

APPENDIX- A

Table 1. All Research Papers on DSSC's Published by the IFS, Hantana, Sri Lanka with their salient analysis

(also included in the Bibiliography Section)

SR. NO	RESEARCH PAPER	AUTHOR / S	PUBLISHED DATE & MEDIA	RESEARCH AREA
1	Sensitization of nano porous films of TiO_2 with santalin (red sandle wood pigment) and construction of dye-sensitized solid-state photovoltaic cells	K.Tennakone, G.R.R.A.Kumara I.R.M.Kottegoda, V.P.S.Perera, P.S.R.S. Weerawardana	9 July 1998 Journal of Photochemistry & Photobiology 117(1998) 137-142.	Dye-Sensitized solid state photovoltaic cells of santalin constructed by depositing p-Cul or P-CuCNS on santalin coated with nano porous TiO_2 films. Observed effects of light absorbed by the dye-molecules injecting electrons into TiO_2 and holes into Cul (or CuCNS) generating short-circuit photocurrent of ~ 6mA/cm^2 and photo voltage of ~450 mV at 800 W/m^2 simulated sunlight.
2	Dye-sensitized solid state photovoltaic cell based on composite zinc oxide / tin oxide films.	K.Tennakone V.P.S.Perera I.R.M.Kottegoda G.R.R.A.Kumara	29 September 1998 Journal of Physics 32 (1999) 374-379.	In Dye-sensitized fully solid state cells having the structure of rough n-type semiconductor film comprising Zinc and Tin (IV) Oxide/Ruthenium-bipridyl Complex / p-Cul are found to generate high short circuit currents and open circuit voltages.
3	An efficient dye-sensitized photo electrochemical solar cell made from oxides of Tin and Zinc.	K.Tennakone G.R.R.A.Kumara I.R.M.Kottagoda V.P.S.Perera	19November 1999 Chem. Communications, 1999, 15-16.	A photo electrochemical solar cell made from a porous film consisting of a mixture of Ruthenium bipridyl complex suppresses recombination of photo generated electrons and dye cations generating a short

				circuit photocurrent of 22.8 mA/cm^2 and open circuit voltage 670mV in direct sunlight 900W/m^2) with an efficiency of ~ 8%
4.	Dye-Sensitized Photo electrochemical Cells based on Porous SnO_2/ZnO composite and TiO_2 films with a Polymer electrolyte.	K.Tennakone G.K.R.Senadheera V.P.S.Perera I.R.M.Kottagoda L.A.A.de Silva	13 August 1999 American Chemical Society Chem. Mater 1999, 2474 - 2477	Polyacrylonitrile polymer electrolyte based photo electrochemical cells have been fabricated with Ruthenium bipridyl complex as the sensitizer using porous films of SnO_2/ZnO and TiO_2 films. For both types short circuit currents and efficiencies obtained.
5.	The possibility of ballistic electron transport in dye-sensitized semiconductor nano crystalline particle aggregates.	K.Tennakone I.R.M.Kottagoda L.A.A.de Silva V.P.S.Perera	17August 1999 Semiconductor Science & Technology. 14(1999) 975-978	A dye sensitized photo electrochemical cell made from nano-porous composite film consisting of Tin and Zinc oxides generates exceptionally high photo currents at an optimum mixing ratio of the two oxides.
6	Photocatalytic activity of dye-sensitized Tin oxide nano crystalline particles attached to zinc oxide particles: Long distance electron transfer via ballistic transport of electrons across nano crystallites	K.Tennakone J. Bandara	7 July 2000 Applied Catalysis A: General 208 (2001) 335-341	A catalyst comprising chains of dye-sensitized SnO_2 nano crystallite (10-15nm) attached to larger ZnO (~600nm) particles is found to photogenerate hydrogen from water with visible light in the presence of a hole scavenger.
7.	Highly stable dye-sensitized solid-state solar cell with the semi	K.Tennakone G.K.R.Senadheera	1 August 2000 Applied Physics Letters, American	Construction of a dye sensitized solid state solar cell with the semiconductor

	conductor 4 CuBr $3S(C_4H_9)_2$ as the Hole collector)	D.B.R.A.de Silva I.R.M.Kotagoda	Institute of Physics Vol.77 No.13	4 CuBr $3S(C_4H_9)_2$ as the hole collector is reported. Cell delivered a short circuit photo current of ~ $43mA/cm^2$ and open circuit voltage of 400 mV at 1.5 air mass,1000 Wm^{-2} sunlight.
8	Dye-sensitized solar cells with the hole collector p-CuSCN deposited from a solution in n-propyl sulphide	G.R.R.A.Kumara, A.Konno, G.K.R.Senadheera P.V.V.Jayaweera D.B.R.A.de Silva K.Tennakone	30 September 2000 Solar Energy Materials & Solar Cells 69(2001) 195-199.	DSSC formed with CuSCN on Ruthanium complex dye coated nano crystalline TiO_2 films found to yield higher short circuit current, open circuit voltage and efficiency compared to cells made with CuSCN by other deposition techniques.
9	Photoelectrochemical cells made from SnO_2 / ZnO films sensitized with Eosin Dyes	G.R.A.Kumara A.Konno, K.Tennakone	29 November 2000 The Chemical Society of Japan Chemistry Letters	DSSC constructed with SnO_2/ZnO, SnO_2 and TiO_2 film sensitized with Eosin Y dye observed to yield high short circuit photocurrent and efficiency compared to cells made from SnO_2, ZnO or TiO_2.
10.	Suppression of recombination's in a Dye-Sensitized Photo electrochemical Cell made from a film of Tin IV Oxide crystallites coated with a thin layer of Aluminium Oxide.	G.R.R.A.Kumara, K.Tennakone, V.P.S.Perera A.Konno	5 December 2000 Institute of Physics, Journal of Physics D (Applied Physics) 34 (2001), 868-873	DSSC consisting of a film of SnO_2 coated with ultra fine particles of Al_2O_3 generates exceptionally high open circuit voltages as compared to a cell made only from SnO_2.
11.	Dye sensitized solar cells : New ideas for their improvement .	K. Tennakone	December 2000 Proceedings of the 5th workshop on low cost electronic materials, Solar cells and renewable energy sources, Colombo 22-25 Feb 2000 : 78 - 80	Instructions for improvement of efficiency, stability.
12.	Fabrication of solid state dye sensitized TiO_2 photo	G.K.R. Senadheera,	December 2000. Proceeding of	Investigation of Solid State Solar cells to prevent

	voltaic cells with Cu CNS.	K. Tennakone V.P.S. Perera	5th workshop on Low Cost Electronic Materials, Solar Cells and Renewable Energy Sources, Colombo 22 – 25, Feb 2000; 81-85	leakage of liquid electrolyte (stability enhancement)
13.	Dye-Sensitized Solid-State Solar Cells: Use of Crystal Growth Inhibitors for deposition of the Hole Collector.	G.R.A.Kumara A.Konno K.Shiatsuchi T.Tsukalara K.Tennakone	31 December 2001 American Chemical Society 14, 954-955	Solid State DSSC characteristics investigated are reported.
14.	Solid State Dye-Sensitized Photocell based on Pentacene as a hole collector	G.K.R.Senadheera P.V.V.Jayaweera V.P.S.Perera K.Tennakone	8 October 2001. Solid Energy Materials& Solar Cells 73 (2002) 103 - 108	Solid State dye sensitized photovoltaic cell with Pentacene deposited onto Ruthenium dye coated TiO_2 electrode doped with Iodine fabricated and evaluators
15.	Enhanced Efficiency of a Dye-Sensitized Solar Cell made from MgO coated Nano crystalline SnO_2	K.Tennakone J.Bandara P.K.M.Bandaranayake G.R.A.K.Kumara A.Konno	23 May 2001 Japan Society of Applied Physics Vol. 40 (2001) pp.L732-L734.	Nano crystalline SnO_2 dye sensitized photo electro chemical solar cells coated with SnO_2 crystallites with thin film of MgO observed to enhance voltage and efficiency to 650-700 mV and approx 6.5% respectively.
16.	Enhancement of the energy and quantum conversion efficiencies of a photo electrochemical cell sensitized with a combination of cationic and	K.Tennakone G.K.R.Senadheera P.V.V.Jayaweera	17 May 2001 Current Science Vol. 81, No.1	Dye bromopyrogallol red surface complexes to TiO_2 adsorbs electron donating cationic dye, binding it to anionic sulphonate site. Resulting double dye film

	anionic dyes.			shows enhanced current and energy conversion efficiencies and a broad spectral response owing to charge transfer.
17.	Dye-Sensitised solid state Photovoltaic cells: Suppression of Electron - Hole Recomb-inations by deposition of the Dye on Thin Insulating Film in contact with a semiconductor.	K.Tennakone V.P.S.Perera I.R.M.Kottagoda I.A.A.de Silva G.R.R.A.Kumara A.Konno	15. May 2001. Journal of Electronic Materials, Vol.30, No.8, 2001	Heterojunction n-SnO_2/ Ru-dye/ p-CuI prepared by depositing ruthenium bipridyl dye on a mesoporous film of SnO_2 coated on a thin film of Al_2O_3 behaved as a DSSC
18.	Probing the tunneling of electrons from SnO_2 to ZnO in dye- sensitization of com-posite SnO_2/ZnO by use of generated H_2O_2 via reduction of O_2	J.Bandara K.Tennakone P.Binduhewa	5 September 2001 Royal Society of Chemistry, U.K. Journal of Chemistry 2001,25, 1303-1305	A composite system of SnO_2/ZnO semiconductor found to generate higher H_2O_2 yield than individual oxide semiconductor when sensitized with various dyes.
19.	Surface mechanism of Molecular Recognition between Aminophenols and Iron oxide surfaces	J.Bandara K.Tennakone J.Kiwi	29 January 2001. American Chemical Society, USA Langmuir 2001, 3964-3965.	The degradation of 2-aminophenol on hematite proceed more favourably than the degradation of 3 and 4 aminophenol because of the formation of a strong surface complex between 2 aminophenol and hematite that facilitates charge transfer to oxide surface.
20.	Interparticle charge transfer in Dye-Sensitized Films composed of two kinds of semiconductor crystallites.	J.Bandara K.Tennakone	22 January 2001 Journal of Colloidal & Interface Science 236, 375-378 (2001)	Interparticle charge transfer between different types of semiconductor crystallites in band gap excitation or dye sensitization was analysed
21.	Nanoporous TiO_2 Solar Cells Sensitized with Iron (II) complexes of brompyrogallol red ligands.	P.M.Jayaweera S.S.Palayangoda K.Tennakone	16 January 2001. Journal of Photochemistry & Photobiology,	Complexation of bromo pyrogallol ligand with di (aqua) bis (oxalate) iron (II) moiety [Fe(II) H_2O_2 $C_2O_4]^2$ shows enhanced

			Elsevier, 140 (2001), 173-177	photovoltaic properties.
22.	Fabrication of Dye-Sensitized Solar Cells using Triethylamine Hydrothiocyanate as a CuI crystal Growth Inhibitor.	G.R.A.Kumara S.Kaneka M.Okuya K.Tennakone	2 October 2002. American Chemical Society, USA. Langmuir 2002, 18,10493-10495.	The hole mobility in the hole collector of a DSSC investigated.
23.	Cobolt (II) - bis(1,10-phenanthroline) triphenyl methane dye complexes and their photo sensitization properties in nanoporous photovoltaic devices.	P.M.Jayaweera, S.S.Palayangoda, K.Tennakone, R.G.C.R.Gamage	21 September 2002 Current Science Vol83, No.11	Bromopyrogallol red pryocatechol violet the two tripheryl methane type ligands can be readily complexed with Cu[(1,10-phen)$_2$]^2 moiety. The resulting complexes were found to be capable of enhancing photovoltaic properties when compared with corresponding ligands
24	Dye-sensitized photo electrochemical and solid state solar cells: Charge separation, transport and recombination mechanisms.	K.Tennakone P.V.V.Jayaweera P.K.M.Bandara	1 July 2002 Journal of Photochemistry & Photobiology, 158 (2003), 125 – 130.	Experimentation of dye sensitized photo electro chemical cells made from SnO2, ZnO and comparison with similar cells based on TiO_2 gives insight into the nature of charge separation, transport, and recombination.
25.	Composite Tin and Zinc oxide nano crystalline particles for enhanced charge separation in sensitized degradation of dyes.	J. Bndara K.Tennakone, P.P.B.Jayatilake	10 June 2002 Chemosphere 49 (2002), 439-445	Composite ZnO / SnO_2 degradation has been studied with sensitized degradation of dyes eg. Eosin Y in relation to efficient charge separation properties of the catalyst.

26.	Die-Sensitization of Magnesium oxide coated Cadmium sulphide	P.K.M.Bandara P.V.V.Jayaweera K.Tennakone	10 April 2002 Solar Energy Materials and Solar Cells	Nano crystalline films of CdS sensitized with ruthenium N_3 dye show a feeble photo-response, but when an ultra thin outer shell of magnesium oxide is deposited on CdS, photo-response greatly enhanced.
27.	Effect of Imidazolium Salts on the performance of solid state Dye-Sensitized photovoltaic cells using Copper Iodide as Hole Collector	A.Konno G.R.A.Kumara R.Hata K.Tennakone	7 February 2002 Electrochemistry, 70, N0.6 (2002)	DSSC'S in general have problems of long term Photostability. Addition of several 1-ethyl 3 methylim-idazolium (Im) salts improved the performance and stability.
28.	Die-Sensitized Composite Semi conductor nano structures	K.Tennakone P.K.M.Bandaranyake P.V.V.Jayaweera A.Konno G.R.R.A.Kumara	Physics, Physics E 14 (2002), 190-196	Deposition of ultra thin shells of insulators or high band gap semiconductors on crystallites, a dramatic increase in open circuit voltage and quantum conversion efficiencies observed.
29.	Nanocrystalline TiO_2 films for Dye-Sensitized Solid State Solar Cells.	G.R.A.Kumara S.Kaneko M.Okiya A.Konno K.Tennakone	Publication of Ceramic Society of Japan, Key Engineering Materials Vol. 228-229 (2002) pp 119-124	A special type of TiO_2 film that is less porous but factually rough is used to prevent short circuiting when preparing films to overcome difficulties in sealing of liquid electrolyte type DSSC's
30.	Dye-Sensitized Semiconductor Nanostructure for solar	K.Tennakone	Ceylon Journal of Science, Physical Science	Insight gained from experimental and theoretical studies on DSSC's made from different

	energy conversion		9(1), 1-8(2002)	semiconductors and its composites summarized.
31.	Dye sensitized semiconductor nanostructures for solar energy conversion.	K. Tennakone	October 2002 Ceylon Journal of Science (Physical Science). 9 (1) : 1 - 8	Structural analysis of TiO_2 film.
32.	Nanoporous TiO_2 photo voltaic cells sensitized with metalchromic triphenylmethane dyes	P.M. Jayaweera A.R. Kumarasinghe K. Tennakone	December 2002, Journal of Photo Chemistry and Photobiology A: Chemistry. 126: 111-115	
33.	Surface trap mediated recombination in dye sensitized solid state solar cell with CuI as the hole collector.	V.P.S. Perera K. Tennakone	March 2003. Proceedings of the 19th Technical Session – March 2003, Institute of Physics 51-57	
34.	The effect of MgO on Enhancement of Efficiency in solid state Dye sensitized Photo Cells fabricated with SnO_2 and CuI.	S.Perera G.K.R.Senadheera K.Thennakone S.Ifo T.Kitamura Y.Wade S.Yanogide	9 September 2002 The Chemical Society of Japan 76,659–662 (2003)	In DSSC's made for SnO_2 and MgO enhancement of photocurrent and voltage found when percentage of MgO to SnO_2 was around 4 wt %, due to formation of a thin energy barrier which suppresses the recombination of photo electrons
35.	Efficient Die Sensitized Photo Electrochemical Cells made from nano crystalline Tin (IV) oxide – Zinc Oxide Composite	G.R.A.Kumara K.Tennakon. I.R.M.Kottagoda	7 January 2003 Institute of Physics Semiconductor Science	This paper explains in detail how a thin shell of ZnO on SnO_2 could effectively counteract recombination of electrons with acceptors in

	films	P.K.M.Bandara A.Konno, M.Okuya S.Kanebu, K.Murakam	&Technology, UK. 18(2003),312-318	electrolyte (eg. I_3^-) and increase efficiency of DSSC's based on nano crystalline films of TiO_2.
36.	Recombination processes in Dye-sensitized Solid State Solar Cells with CuI as the hole collector	V.P.S.Perera K.Tennakone	30 March 2003 Solid Energy Materials & Solar Cells 79(2003),249-255	In solid state DSSC's stoichiometrically excess Iodine molecules adsorbed at the CuI surface acts as hole trapping site that mediate recombination.
37.	Sensitization of Aluminium chloride adsorbed Tin (IV) oxide nanocrystalline film with Rose Bengal	V.P.S. Perera G.K.R.Senadheera K.Tennakone	29 April 2003 Journal of Colloidal and Interface Science 265 (2003),428-431	DSSC's made from anionic dye Rose Bengal exhibits enhanced quantum and energy conversion efficiencies.
38.	Depleted semiconductor Quantum Nanowire in an electrolytic medium	K.Tennakone P.V.V.Jayaweera	27 May 2003 Superlattices and Microstructures, Elsevier Ltd. 33(2003), 23-28	It is shown that electron lateral confinement leading to sub bands can be readily achieved by surrounding a doped semiconductor nanowire in an electrolytic medium.
39.	Dye-Sensitized Solid State Photovoltaic Cells based on dye multilayer semiconductor nanostructures	V.P.S.Perera P.K.D.P.Pitigala P.V.V.Jayaweera, K.M.P.Bandaranayake K.Tennakone	29 October 2003. American Chemical SocietyJournal of Physical Chemistry, B 2003,107,13758-13761	Attempts made to improve efficiency of DSSC's if ways are found to broaden the spectral response resolving fundamental issues involved.
40.	Fabrication of n-p junction electrodes made of n-type	J.Bandara	10 November 2003 Solar Energy	The n-P junction electrode fabricated coating nano

	SnO_2 and p-type NiO_2 for control of charge recombination in DSSC's	C.M. Divaratne S.D.Nanayakkara	Materials Solar &Cells, Science Direct 81 (2004), 429-437	crystalline SnO_2 thin film with a thin layer of p-type NiO found to increase photocurrent and photo voltage.
41.	Construction of photovoltaic device by deposition of thin films of conducting polymer polythio cyanogens.	V.P.S.Perera P.V.V.Jayaweera P.K.D.D.P.Pitigala P.K.M.Bandaranayake G.Hastings A.G.U.Perera K.Tennakone	18 December 2003 Science Direct, Synthetic Metals 143 (2004) 283 - 287	A method is developed for electrode position of conducting polymer polythiocyanogen on conducting Tin Oxide glass or other conducting substrate by anodic discharge of SCN ions from a solution of KSCN in propylene carbonate.
42.	Sensitization of nano structured TiO_2 by Electrostatic coupling of Ionic Dyes to Ionic Absorbates.	P.K.D.D.P.Pitigala M.K.I.Seneviratne V.P.S.Perera K.Tennakone	5 April 2004 American Chemical Society Langmuir 2004, 20, 5100 - 5103	DSSC's of configuration n-TiO_2/X- Y/p – CuSCN where, X=trihydrobenzonic acid mercurochrome Y=methyl violet were constructed. These cells found to be more efficient and delivered higher short circuit currents and open circuit voltages compared to cells based on methyl violet or mercurochrome, by extending their spectral response.
43.	Dye-sensitized solar cells made from nano crystalline TiO_2 films coated with outer layers of different oxide materials.	K.M.P.Bandaranayake M.K.I.Seneviratne P.M.G.M.Weligamuwa K.Tennakone	23 May 2004 Science Direct, Coordination Chemistry Review 248(2004)	Higher efficiencies obtained from DSSC's of TiO_2 type when these crystallites in the film coated with different oxide materials of varying thickness.

			1277-1281.	
44.	A Solar Cell sensitized with three different dyes	V.P.S.Perera P.K.D.Pitigala M.K.S.Seneviratne	2 June 2004 Science Direct, Solar Energy, Materials & Solar Cells 85(2005),91-98	In order to broaden the spectral response and to enhance the efficiency to DSSC's. construction of a semiconductor dye hetero structure of configuration n-TiO_2/D_1/ P-CuSCN/D_2/ P-CuSCN/D_3/ P-CuSCN where, D_1=Fast Green D_2 = Rhodamine 6 G D_3 = Acridine Yellow effected and evaluated.
45.	The effect of particle size and conductivity of CuI layer on the performance of solid state DSSC's	A.Konno T.Kitagawa H.Kida G.R.A.Kumara K.Tennakone	6 July 2004 Science Direct, Current Applied Physics 3 (2005) 149-151	Conductivity of CuI film greatly increased by addition of thiocyanate salts and efficiency improved.
46.	Molecular Rectification application in Dye-Sensitized Solar Cells	M.K.I.Seneviratne P.K.D.D.P.Pitigala V.P.S.Perera K.Tennakone	9 December 2004 American Chemical Society Langmuir 2005 21, 2997-3001	A DSSC hetero junction configuration of n-TiO_2/PD-Cu PC-MV/P-CuSCN (where PD=3,4, pyridine dicarboxylic acid anchored to TiO_2, CuPC=Copper (IF) Phthallcyamn tetrasulphonic ionicaly linked to PD, MV=methyl violet complexed to CuPC) developed to demonstrate applicability of molecular

				rectification of DSSC's as a strategy to suppress recombination.
47.	Doping of CuSCN films for enhancement of conductivity: Application in DSSC's	V.P.S.Perera M.K.I.Seneviratne P.K.D.D.P.Pitigala T.Tennakone	29 December 2004 Science Direct, Solar Energy Materials & Solar Cells 86 (2005), 443-450	Construction of solid state DSSC's requires high band gap (therefore transparent)hole collectors which can be deposited on a dye coated nano crystalline semiconductor surface without denaturing the dye presented.
48.	Dye sensitized Solid State solar cells made form magnesium oxide coated nano crystalline TiO_2 film, : Enhancement of the efficiency.	G.R.R.A. Kumara	2004 Journal of Photobiology and photo chemistry A: Chemistry MFN 4195 164, 183	
49.	Solid State dye sensitized solar cell with P-type NiO as hole collector.	J. Bandara A. Jayasundera	2005 Solar Energy Methods and Solar Cells 85(3), 385 - 390	
50.	Dye sensitized near infra red room temperature photo voltaic photon detectors.	P.V.V. Jayaweera P.K.D.P. Piyadasa K. Tennakone	2005 Applied Physics letters 85 (23), 5754 - 5756	
51.	Enhancement of photo voltage of dye sensitized solid state solar cells by introducing high band gap oxide layers.	J. Bandara A. Jayasundera H.C. Weerasinghe	2005 Solar Energy Materials and Solar Cells 85 (4), 341-350	
52.	Photosensitization of nanocrystalline TiO_2film by a polymer with two carboxylic groups, poly3 thiophenemalonic acid.	G.K.R. Senadheera T.Kitamura Y. Wade Yanaside	2005 Solar Energy Materials and Solar Cells 88(3), 315 - 322	
53.	The role of n-p junction electrodes in minimizing	J. Bandara	2005 Journal of	

	the charge recombination of and enhancement of photo current and photo voltage	V.W. Pradeep R.G.S.T. Bandara	Photochemistry and Photobiology A: Chemistry 170(3), 273 - 278	
54.	Versatile preparation methods for mesoporous TiO_2 electrodes suitable for sold state dye sensitized photocells	G.K.R. Senadheera S. Kobayashi J. Kitamura Y. Wade S. Yongido	2005 Bulletin of Material Service MFN 5149	
55.	Dye sensitized Solid State Solar Cell sensitizedwith Coumarin derivatives	G.R.R.A. Kumara T. Kawaguchi. Y. Ketoh K. Tennakone	2005 Pacific Chemistry Congress, Honolulu, Hawaii, U.S.A. 15-20 Dec 2005, MFN 5523	
56.	Large area dye sensitized solar cells : Material Aspects of Fabrication	G.R.A. Kumara S. Kaneko A. Konno M. Okyo K. Tennakone	2006 Solar Energy Materials and Solar Cells 14 (7), 643 - 651	
57.	Shinso Leaf Pigment for dye sensitized solid state solar cells	G.R.A.Kumara S.Kanko A.Konno	2006 Solar Energy Materials and Solar Cells 90 (9) 1220 - 1126	
58.	Dye-Sensitized Solar Cells with extremely thin liquid film as the Redox Electron Mediator	G.R.A.Kumara S.Kaneko A.Kanno M.Okuya K.Tennakone	14 January 2005 The Chemical Society of Japan, Chemistry letters, Vol. 34, No.4, (2005)	A hybrid DSSC with a thin film of liquid is interposed between the dye coated nano crystalline semiconductor surface and a solid hole collector demonstrated.
59.	Sensitization of nano crystalline SnO_2 films with Indoline dyes	B.O.Agyeman S.Kaneko	27 May 2005 Japanese Journal of Applied Physics	Using Indoline dyes as sensitizers for DSSC's based on SnO_2. Efficiency of 2.8% achieved, compared to 1.2%

		A.Kumara M.Okuya K.Murakami A.Konno K.Tennkone	Vol. 44, No. 23, 2005,731-733	for rutherium bipiridyl dye (N-719) under same experimental conditions.
60.	T*i*O_2 nano porous photo electrochemical cells (PEC's) sensitized with mixed cationic /anionic dye systems: Role of the second cationic florescent dye on photocurrent enhancement	P.M.Jayaweera R.M.S.P.Rajapakse K.Tennakone	22 Jane 2005 Science Direct, Chemical Physics Letters 412 (2005) 29-34	Bromopyrogallol red (BPR) an anionic dye material used in DSSC's as the sensitizer in conjunction with a fluorescent dye rhodomine B and acridine orange enhanced photovoltaic properties.
61.	Chromopore linked conducting polymers attached to semiconductor surfaces: A strategy for development of DSSC's	M.K.I.Seneviratne P.K.D.D.P.Pitigala K.Tennakone	24 June 2005 American Chemical Society Journal of Physical Chemistry B, 2005 109,16030-16033	Attaching chromopores to a conducting polymer chain anchored to semiconductor surface found to be a good strategy for development of DSSC's
62.	As enhancement of Photo properties of solid state TiO_2/dye/CuI type cells by coupling mercurochrome with natural juice extracted from pomegranate fruits.	P.M.Sirimanne I.Seneviratne K.Tennakone	24 June 2005 The Chemical Society of Japan Chemistry letters Vol.34, No.11	Electrostatic coupling of mercurochrome with an anthrocyanin pigment extracted from pomegranate fruits result on enhancement of photovoltaic properties of TiO_2/dye/CuI solid state solar cells.
63.	1/f Noise and DSSC's	P.V.V.Jayaweera P.K.D.D.P.Pitigala A.G.I.Perera K.Tennakone	28 June 2005 Semiconductor Science and Technologies Institute of Physics U.K. Doi:10,1088/0268-	The adsorbed molecular species such as H_2O and I_2 that produce electron acceptor states on TiO2 surface found to generate $\frac{1}{f}$ noise in the electric current through nano crystalline films of T*i*O_2 due to trapping and de-trapping

			124/20/0/000	of electrons at the surface states.
64.	Efficient Ouasi Solid Solar Cells employing , molten salt electrolytes	G.K.P. Senadheera N.S. Silva	July 2006 Sri Lanka Journal of Physics Vol. 7 (2006) 15-22	Use of molten salt electrolyte to enhance long term stability.
65.	Synthesis and characterization of carboxylated thiophene co polymers and their use in photovoltaic cells	T.M.R.C. Fernando G.K.R.Senadheera	25 September 2008. Current Science Vol.95, No.6	Several 3 substitute thiophene and pyrole bearing co polymers were chemically synthesized and their possible usage as sensitizers investigated.
66.	Tuning of flat band potentials of nanocrystalline TiO_2 and SnO_2 particles with an outer shell of Mg O layer.	T. Bandara U.V. Pradeep	2008 Science Citation Index, MFN 6399 517(2) 952 - 956	
67.	Polyethylene oxide PEO-based anion conductivity solid polymer electrolyte for PEC Solar Cells	T.M.W.J. Bandara M.A.K.L. Dissanayake	2008 Science Citation Index MFN 6579 12 (4002) 913-917	Use of Solid polymer electrolytes for enhance long term stability.
68.	Natural Anthrocyanins as photosensitizers for DSSC's	J.M.R.C.Fernando G.K.R.Senadheera	30 July 2008 Current Science Vol.95, No.5	Different natural pigments containing anthrocyanins extracted from tropical flowers studied as possible sensitizers for DSSC's. Overall efficiency of these cells varied from 0.2. to 1.1%. Hibiscus surothenin (magenta flower) gave best photosensitized effect
69.	Efficient passivation of SnO_2 nanocrystallites by Indoline D-149 via via dual	Y.P.Y.P. Ariyasinghe T.C.K. Wijayarathne I.G.C.K. Kumara I.P.L. Jayantha	19 October 2010 Journal of Photochemistry & Photobiology A	An efficiency exceeding 3% reported for the first time in SnO_2 based dye solar cells consisting of Indoline D 149

	chelation	C.A. Thtawattage W.S.S. Gunathilake G.K.R. Senadheera V.P.S. Perera	Chemistry xxx (2010) xxx – xxx (Article in press)	dye.
70.	Nanocrystalline TiO_2 photo excited with natural dyes	P.A,Abeygunawardena S.Palakubura C.A.Thotawattage M.A.K.L.Dissanyake G.K.R.Senadeera	28 July 2011 Solar Asia 2011 International Conference Proceeding	Natural dye sensitizationof nanocrystalline TiO_2 photocrodes
71.	Utilization of Natural pigments excited from Henna leaf in combination with Gelatine as sensitizer in photoelectro chemical solar cells.	C.N.Nuperachchi T.R.C.K.Wijayaratna V.P.S.Perera	28 July 2011 Solar Asia 2011 International Conference Proceeding	Natural dye sensitization with steno leaf in Geletine of DOC's
72.	Comparison of Natural pigments in Black Tea and Green Tea with DSSC's	C.N.Nuperachchi C.A.Thotawattage G.K.R.Senatheera V.P.S.Perera	28 July 2011 Solar Asia 2011 International Conference Proceedings	Natural dye sensitization with Black and Green Tea
73.	Evaluation of Dyes from Melastrom Malabothium: A native plant of Borneo as a poterial natural dye for DSSC's	P.Ekanayake R.Zain M.Iskander K.Tennakoon S.Yoshikawa G.K.R.Senadheera	28 July 2011 Solar Asia 2011 International Conference Proceedings	Analysis of natural dyes from plants grown in Borneo.

74.	Flourence based organic dyes for DSSC’s	K.R.J.Thomas	28 July 2011 Solar Asia 2011 International Conference Proceeding	Sunthesis and analysis of Flourine based organic dyes for DSSC’s

APPENDIX –B

Research Papers on DSSC's published by Institutions / Universities in Sri Lanka other than at the IFS (also included in the Bibiliograpy Section)

1. Bandara, T., Dissanayake, M.A.K.L., Somasundaram, Bandara, L.R.A.K., Illeperuma, O.A., Varaprathan, K., Mellander, S.C., Postgraduate Institute of Science,University of Peradeniya, Peradeniya. 1994.

2. Bandara, L.R.A.K., Dissanayake, M.A.K.L., Ekanayake, G.V.K., Illeperuma, O.A., Weeraman, T.T.K., Department of Chemistry, University of Peradeniya. 1998. Dye-Sensitized photoelectrochemical solar cells with PEO based solid polymer electrolytes. Proceedings of the workshop on renewable Energy Sources, Colombo 10-11 Feb. 1998,

3. Fernando, C.A.N., Kumarawadu, I., Kiyagawa, A., Suzuki, M., Department of Physics, University of Ruhuna, Matara. 1999. Crystal Violet dye-sensitized photocurrent by participation of surface sates on P. Cu SCN photocathode. Solar Energy Materials - Semi conductor materials.

4. Fernando, C.A.N., Weththasinghe, S.K., Department of Physics, University of Ruhuna. 2000. Phtocurrent generation of a dye sensitized solid state photovoltaic cell made from n-Cu_2O and P – Cu SCN thin' film. Proceedings of the 5th Workshop on low cost Electronic Materials, Solar Cells and Renewable Energy Sources. Colombo, 22-25 Feb.2000: 86-93.

5. Fernando C.A.N., Weththasingha, S.K., Department of Physics, Ruhuna, Matara. 2001. Improved photocurrent quantum efficiency and kinetics of photocurrent generation of a dye sensitized solid state solar photovoltaic cell made from n Cu_2O and P-Cu SCN thin film. Japanese Journal of Applied Physics.

6. Fernando, C.A.N., Takashi, K., Kitagawa, A., Suzuki, M., Wethasinghe, M., Kunarawadu, I., Department of Physics, University of Ruhuna, Matara. 2001. Remarkable stability of the enhanced sharp photocurrent in netyhlinolet – C18 and Solar Energy Materials.

7. Fernando, C.A.N., Kumarawadu. I., Department of Physics, University of Ruhuna, Matara. 2001. Colloidal P-CuI sensitized double dye system. Semiconductor Science and Technology.

8. Fernando, C.A.N., Priyankara, W.TC., Dharmadasa, I.M., Department of Physics University of Rhuna, Matara. 2002. Photocurrent of Ruhuna, Matara. 2003. Photocurrent enhancement of interlocked LB film dye layers in a P-Cu SCN sensitized photoelectrochemical cell. Renewable Energy.

9. Fernando, C.A.N., Department of Physics, University of Ruhuna, Matara. 2002. Hydrogen production from photoelectrochemical cells using low cost semiconductor film, and dye sensitized solar cell production with ordered and disordered molecular arrangement.

10. Jayaweera, P.M., Department of Chemistry, University of Colombo, Colombo. 2003. Photocurrent conversation efficiency of solar cells sensitized with a combination of ationic and anionic materials.

11. Ravirajan, P., David, T.R., Department of Physics, University of Jaffna, Jaffna. 2005. Controlling recombination kinetics of hybrid, polymer/ metal oxide solar cells.

12. Premalal, E.V.A., Perera, V.P.S., Open University of Sri Lanka, Nugegoda. 2005. Photovoltaic effects of dye-deposited metal electrodes in electrolytic media. Proceedings of the 21st Technical Session – Institute of Physics, March 2005: 57-61.

13. Director, National Energy Research and Development (NERD) Centre, J-Ela. 2006. Cheaper ways to produce Dye-Sensitized Solar Cells.

14. Hussain, F.M., Sirakumar, V., Department of Physics, University of Peradeniya, Peradeniya. 2007. Structural studies of plant pigments used in dye sensitized solar cells. Proceedings of the University of Peradeniya Research Sessions ,Purse 2007. 12 (ii): 275 - 277.

15. Bandara, T., Dissanayake, M., Illeperuma, O.A., Varaprathen, V., Vignarookan, K., Mellander, P.E., 2008. Postgraduate Institute of Science, University of Peradeniya, Peradeniya. Polyethylene oxide based anion conducting solid polymer electrolyte for PRC solar cells.

16. Siripala, W.P., University of Kelaniya, Kelaniya. 2008. Solid state dye sensitized solar cells.

17. Aponsu, G.L.M.P., De Silva, R.C.L., Perera, V.P.S., Open University of Sri Lanka, Nugegoda. 2008. Enhanced photovoltaic effects of dye sensitized solar cells of SnO_2 surface modified with gold nano paricles.

18. De Silva, R.C.L., Liyanage, L.S.G., Perera, V.P.S., Open University of Sri Lanka, Nugegoda. 2008. Electron Kinetics of Dye Sensitized Solar Cells made from Al_2O_3 coated SnO_2 nano crystalline films.

19. Aponso, G.L.M.P., Premalal, E.V.A., Liyanage, L.S.G., Perera, V.P.S., Open University of Sri Lanka, Nugegoda. 2008. Deposition of P_t and An Quantum Dots on TiO_2 nanoparticles : study of ballistic electron transport with dye sensitization.

20. Attanayake C.I.F., Premachandra, BAJK' Alwis., AAP., Senadheera, G.K.R., Univeristy of Moratuwa, Sri Lanka and Institute of Fundamental Studies, Sri Lanka. 2008. Design and Development of Dye-Senitized Organic Semiconductor Based Photo Electric System utilizing Nanotechnology for Low cost and Efficient Conversion of Solar Energy to Electricity, Proceedings of 13th ERU Symposium, 6 NOV. 2008 16-17.

21. Attanayake, C.I.F. Premachandra, B.A.J.K., Alwis, A.A.P., Senadheera, G.K.R., University of Moratuwa, Sri Lanka and Institute of Fundamental Studies, Sri Lanka. Solar Powered Naval

Patrol Boat operating Dye-Sensitized Solar Cells (DSSC's) utilizing Fruit and Spice Extracts 2011. National Energy Symposium 2011 of Sri Lanka Sustainable Energy Authority , Ministry of Power and Energy, 13th& 14th August 2011. 71-78.

22. Attanayake, C.I.F., Premachandra, B.A.J.K., Alwis, A.A.P. Senadheera G.K.R., University of Moratuwa and Institute of Fundamental Studies Hantana Open University of Sri Lanka, Palgolla, Sri Lanka. Study of Novel Dyes to support DSSC Research. Confenerence Proceedings of First National Nanotechnology Conference 2012, National Science Foundation of Sri Lanka, 24-25 August 2012. 48-52.

23. Attanayake, C.I.F., Premachandra, B.A.J.K., Alwis, A.A.P., Senadheera, G.K.R., University of Moratuwa and Institute of Fundamental Studies, Hantana and Open University of Sri lanka, Polgolla, Sri Lanka. Dye-Sensitized Solar Cells utilizing over 100 Natural Dyes as Sensitizers. American Institute of Chemical Engineers (AICHE) Annual Meeting , 3 – 8 November 2013 , Global Challenges for Engineering – a Sustainable Future , Hilton, San Fransisco, Union Square , California, U.S.A.

24. Review of Dye Sensitized Solar Cells Research in Sri Lanka . 01 November 2011. Department of Chemical & Process Enginering , University of Moratuwa, Katubedda, Sri Lanaka . C.I.F.Attanayake, B.A.J.K. P remachanadra A.A.P.De Alwis and G.K.R.Senadheera.

25. Comparison of Characteristics and Properties of Rutin and Mangoostein Dye Sensitized Solar Cells . 5 May 2015. Submitted for publication in the Journal of National Science Foundation , Sri Lanka. C.I.F.Attanayake, B.A.J.K.Premachandra, A.A.P. De Alwis and G.K.R.Senadheera.

APPENDIX - C

Construction of DSSC's

Cleaning of conducting glasses with flourine - Doped Tin Oxide Layer

1. First cut conducting glasses into dimensions of 2 cm x 0.5 cm x 0.25 cm with glass cutter.

2. Clean conducting glasses in a beaker filled with Teepol (Soap). Carefully wash them by shaking beaker with Electronic Ultrasonic Cleaner (BRANSON 200) for about 5 minutes.

3. Wash with clean a water.

4. Clean with dilute Sulphuric Acid (1 part by volume acid to 3 parts by volume water. Add acid to water).

5. Wash with clean tap water in an Sulphuric Acid bath of size approximately 2 feet diameter, 8 inches high plastic bucket where about 15 drops of dilute Sulphuric Acid has been added to the bucket containing clear tap water up to about 5" high.

6. Wash with distilled water by inserting a beaker containing Teepol cleaned glasses. Then wash with fresh water and distilled water.

7. Fill beaker containing glasses with Propane 2 OL and boil it by keeping it in a hotplate (100°C). Remove glasses with a Tweezer and keep with conducting side on top (use Multimeter) on a tissue paper.

Preparation of Titanium Dioxide (T*i*O_2) Nano Paste

1. Use a porcelain mortar and pestal by first washing as before at Sr. Nos. 1 to 6 above.

2. Dry it using an electric hair drier to remove moisture.

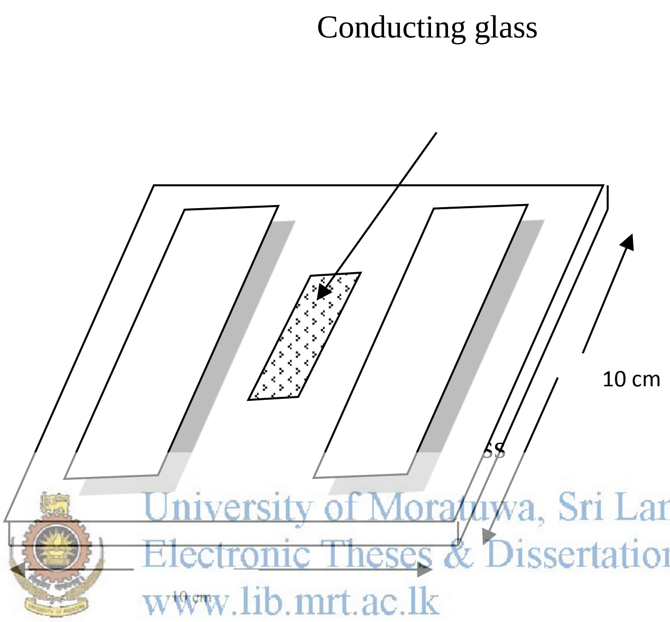
3. Insert 200 mg of T*i*O_2 nanopaste (DEGUSSA powder) (25nm – 30nm) into a plastic boat.

3 &4. Put about 12 drops of Analytical grade Acetic Acid (CH_3COOH) using a glass dropper and mix it with the pestal. Mix well into a paste. (TiO_2 + CH_3COOH = Ti Acetate) add 3 mL Ethanol and grind for 30 mins.

5. Add 1 drop of TRITON X-100 to make the mixture porous, and mix well.

6. Add 3 ml of ETHANOL (Repack) and mix well for about further 30 minutes by hand.

7. Apply one drop of this liquid from the pestal onto the top of conducting glass placed on a glass plate with two slightly higher glass slides on either side parallel to it. Brush with a glass slide to remove excess liquid.(Doctor Blade method)

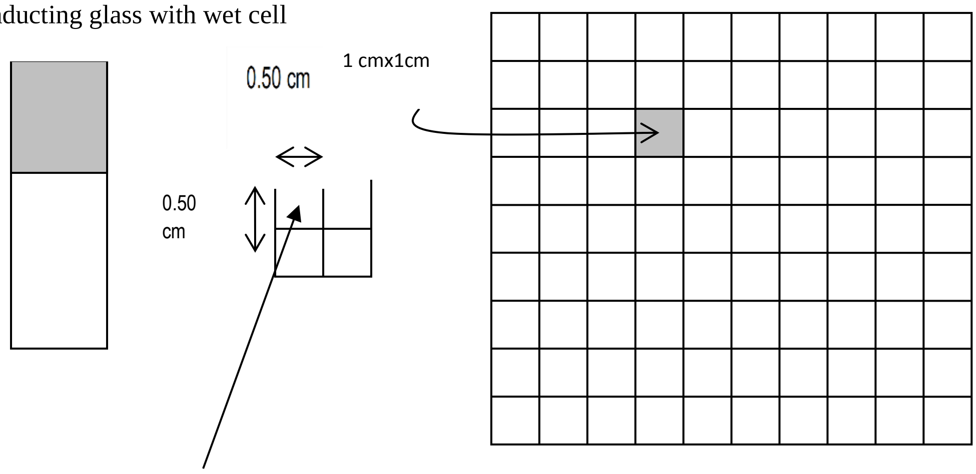


8. Remove conducting glass and place it on a tissue with liquid side on top.

   (Ehanol will evaporate)

9. Remove glass plate with a Tweezer and place it on a graph paper with polythene sheet on top of it.

Conducting glass with wet cell



0.25 Sq,cm each square.

Synter in a oven for 30 mins.

10. Prepare Dye solution with a natural pigment from flowers or fruits with Ethanol in a test tube. (Cut pieces washed with Ethanol and filtered)

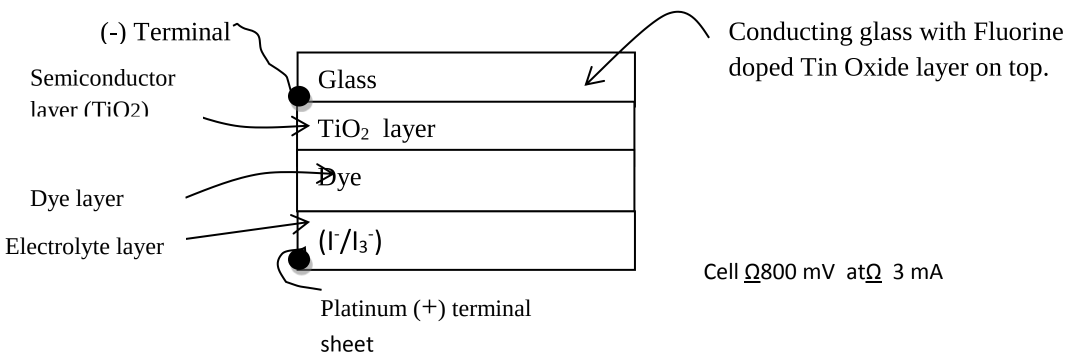
11. Drip the prepared glass conductor into the dye solution in a test tube and keep for about 12 hours.

12. Add Repack EHANOL into the test tube containing conducting glass and wash it.

13. Remove conducting glass and dry it with a hair a dryer till the liquid evaporates.

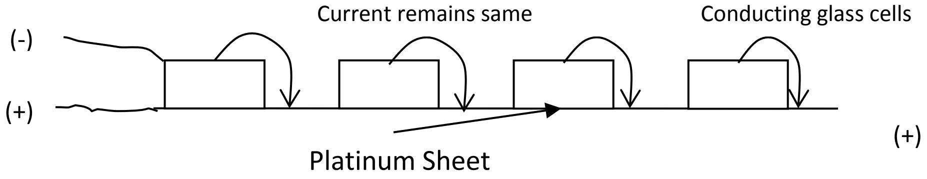
14. Get a glass plated with PLATINUM (10 μm) on one side and place prepared film to touch the PLATINUM and clip it with a metal crocodile clips to hold it in place.

15. Add IODINE Electrolyte (I^-/I_3^-) REDOX into capillary space between PLATINUM plate and prepared film with a dipper. (Wet Cell)

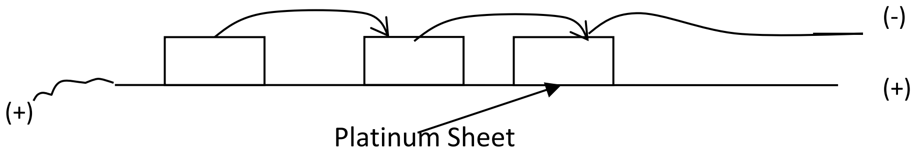


This cell may be sealed with SULAN paper heated to 150ºC by placing on a hot plate.

16. To increase the voltage, add these cells in series.\



17. Connect in parallel to increase current or increase area.



Flow chart for Preparation of DSSC's

Cleaning of Conducting Glasses with Fluorine - doped Tin Oxide Layer

START

↓

Cut Tin Oxide conducting glasses to required size, typically 2cm x 0.5 cm x 0.25 cm with glass cutter

↓

Clean conducting glasses in a beaker filled with Teepol. Wash them by shaking in an Electronic UltrasonicCleaner

(BRANSON 200)

↓

Clean with dilute H_2SO_4 (1 part by volume acid to 3 parts by volume water)

↓

Wash with clean tap water in H_2SO_4 bath of size. approx 2 ft diameter x 8 inch high plastic bucket where 15 drops of dilute H_2SO_4 added.

↓

Wash with distilled water

↓

Fill beaker containing glasses with propane 2 OL and boil on a hot plate (100^0C).

Remove glasses with a tweeze and keep with conducting side on top (use Multimeter) on a tissue paper.

Preparation of Titanium dioxide (TiO_2) Nanopaste and Assembly Of DSSC's

START

↓

Use a porcelain mortar and pestle by first washing as before

↓

Dry with an electric hair dryer to remove moisture

↓

Insert 200mg of TiO_2nanopowder (DEGUSSA 25-30 nm) into a plastic boat and transfer to an agate mortar

↓

Add one drop of Triton X-100 and 12drops of analytical grade Acetic Acid (CH_3COOHto above agate mortar) using a glass dropper and mix with pestle into a paste. And grind for 30 min, finally 3 ml of Ethanol, slowly added which grinding for further conducting glasses (cleaned in Teepol solution in an ultrasonic bath for 15 min, rinsed with water and ethanol and dried) by Doctor Blade Method to obtain 10 □m thick TiO_2 film of 0.25 cm2. Films than heat treated at 500°C for min and cooled to room temperature. Then immersed in alcoholic dye solutionsfor 12 hrs.

↓

Add Iodine - Tri Iodide REDOX electrolyte into a capillary space between Platinum Plate and prepared film with a dipper. (wet cell)

↓

Seal the edges of cell with Sulan paper heated to 150^0C by placing on a hot plate.

↓

To increase Voltage, add these cells in series. To increase current, add these cells in parallel (or increase cell area).
Platinum electrode (+) ve, Tin oxide conducting glass surface (-) ve electrode.

↓

END

APPENDIX – D

NATURAL DYES FROM PLANTS

GROWN IN SRI LANKA

Sr.No.	Name	Botanical name	Parts used
1.	Thekka (Teak)	*Tectona grandis Linn*	Leaves, Bar, Root
2.	Dan pothu	*Syzygium cumini*	Stem, Bark
3.	Kohomba	*Azadirachtin indica*	Bark
4	Rambutan	*Nephelium lappaceum*	Fruit Skin
5	Bulath	*Piper Betle*	Leaves
6	Kos (Jack)	*Artocarpus hetorophyllus*	Saw dust
7	Venivel	*Coscinium fenestratum*	Stem
8	Kurundu	*Cinnamomum verum*	Bark
9	Kothala Himbutu	*Salicia reticulate*	Bark
10	Delum	*Punica granatum*	Fruit skin
11	Rath Handun	*Pterocarpus Santalinus*	Stem
12	Ranawara	*Gassia auriculata*	Flowers
13	Aralu	*Terminalia Chebula*	Fruit
14	Bulu	*Terminalia Belerica*	Fruit
15	Munamal Pothu	*Mimusop elengi*	Stem
16	Welmadata	*Rubia Cardifolia*	Root and Stem
17	Mangoosteen	*Garicnia mangostana*	Fruit Skin
18	Daspethiya	*Tegetus erecta*	Petals
19	Loku Luunu	*Allium cepa*	Skin

20	Wada	*Hibiscus rosa-sinensis*	Used leaves
21	The (Tea)	*Camellia Sinensis*	Used leaves
22	Katarou	*Clitoria ternated*	Flowers
23	Kuppamenia	*Acalypa indica*	Leaves
24	Kopi	*Coffea arabica*	Leaves, seeds
25	Kottamba	*Terminalia catappa*	Riped leaves
26	Devadara	*Erithroxylum manogynum*	Stem
27	Beet root	*Beta vulgaris*	Rysome
28	Kaippu	*Acacia catechu*	Wood
29	Pethangi	*Caesalpinia sappan*	Wood
30	Marathondi	*Lawsonia intermis*	Wood, leaves
31	Seyum wel	*Oldeulandia umbellate*	Roots and tubers
32	Rasandun	*Berberis aristate*	Roots and tubers
33	Ahu Dumbu	*Morinda citrifolia*	Roots and tubers
34	Kudu miris	*Toddalia asiatica*	Roots and tubers
35	Kaha	*Curcuma domestica*	Roots and tubers
36	Kela gas	*Butea monosperma*	Flowers
37	Sepalika	*Nyctanthus arbo-tristis*	Flowers
38	Maliththa	*Woodfordia fruitticosa*	Flowers
39	Anaththa	*Bixa Ovellana*	Seeds
40	Nil awariya	*Indigofera tinctora*	Leaves and stem
41	Hamparilla	*Mallotus phillipiueses*	Stem
42	Welikaha	*Memecyloa capitellatua*	Rhysome
43	Sen kottan	*Semecarpus anacardium*	Seed
44	Kumbuk	*Terminalia arjuna*	Bark
45	Hik	*Lannea coromandelica*	Bark

46	Ipil Ipil	*Leucaena leucocephala*	Bark
47	Gas Penela	*Sapindus trifoliatus*	Seed
48	Wal inguru	*Zingiber cylindricum Moon*	Rhysome
49	Puwak	*Areca catechu*	Seed
50	Kothala Himbutu	*Salicia reticulata*	Wood and root
51	Bowitia	*Osbekia aspera*	Bark
52	Mal ehela	*Cassia fistula*	Bark
53	Mahogani	*Swietenia mahagoni*	Bark, Saw dust
54	Bulu	*Terminalia berelia*	Bark
55	Madan	*Syxgium cumini*	Bark
56	Rath mal	*Ixora coccinea*	Flowers
57	Kaju	*Anacardium occidentale*	Bark and fruit
58	Sera	*Cymbopogon cutratus*	Rhysome
59	Inguru	*Zingiber cylindricum Moon*	Rhysome
60	Rata kaha	*Bixa orellana*	Seed
61	Alisarin	*Hydrorcy anatharaquinones*	Stem
62	Masakka	*Quercus Infectoria*	Rhysome
63	Pipigngna	*Cucumis sativusl*	Stem
64	Gammalu	*Pterocarpus marsupium Roxb.*	Stem
65	Rata-embilla	*Morus Tinctoria*	Fruit
66	Annasi	*Ananas Comosus*	Leaves
67	Kesel	*Musa Sapientum*	Muwa
68	Goraka	*Garcinia Cambogia*	Fruit
69	Nelum	*Nelumbo Nucifera gaerin*	Flowers

70	Carrot	*Daucus carrota*	Fruit
71	Daisiya	*Chrysanthemum Leucanthemum*	Flowers
72	Grass	*Zingiber cylindricum Moon*	Leaves
73	Rosa	*Rosa Indica*	Flower
74	Suriyakantha	*Helianthus Annuus*	Flowers
75	Thakkali	*Solanum Lycopersium*	Fruit
76	Eucalyptus	*Eucalyptus globules*	Bark
77	Lemon grass	*Zingiber cylindicum Moon*	Leaves
78	Nivithi	*Basella alba*	Seed
79	Kadalu	*Impatiens flaccida*	Flower
80	Canas	*Canna ediulis*	Flower
81	Boganvila	*Bougainvilla spectabilis*	Flower
82	Beligeta	*Aegle marmelos*	Fruit
83	Kaduru	*Cerbera manghas*	Fruit
84	Katakaluwa	*Myrica nagai*	Fruit
85	Thembili	*Eugenia bracteata*	Husk
86	Mulberry	*Morus alba*	Fruit
87	Mango	*Mangifera indica*	Fruit, leaves, bark
88	Blackberries	*Rubus Fruitcoses*	Fruit
89	Raspberries	*Rubus Edaem*	Fruit
90	Blueberries	*Vaccinum angustifolium*	Fruit
91	Star Fruit	*Averrhoa Carambola*	Fruit
92	Bankoro	*Morinda Citrifolia*	Bark of roots
93	Annato	*Bixa ovellana*	Dried seed
94	Bayok	*Petaro Spermum*	Bark

95	Jack Fruit	*Artocarpus heterophyllus*	Sawdust
96	Bread Fruit	*Artocarpus affilis*	Inflorescence
97	Shoe Flower	*Hibiscus surattensis*	Flower petals
98	Pokuru Wada	*Hibiscus rocacinesis*	Flower petals
99	Kaneru	*Nerium oleander*	Flower petals
100	Rathu Kathuru murunga	*Sesbania grandiflora*	Flower petals
101	Maha ratmal	*Rhododendron arboretum*	Flower petals
102	Red Sandalwood	*Pterocarpus santalinus*	Wood
103	Big Onion	*Allium Cepa*	
104	Brazlin	*Nephelium Lappaceum*	Wood
105	Tumeric	*Curcuma domestica valet*	Rhizome
106	Walmadata	*Rubia coxdiflora*	Root, stem
107	Mery Gold	*Targets erectra*	Flower petals
108	Rathadin		Stem
109	Kekum pothu		Bark

APPENDIX – E

Best Research - Cell Efficiencies Table at IFS, Kandy (since inception to –date)

SR. NO.	DATE	DYE	BEST EFFICIENCY (%)
1.	July 1998	Santalin red	3
2.	September 1998	Ruthenium (metallic dye complex)	7.8
3.	August 1999	Ruthenium	8
4.	August 1999	Ruthenium	4.1
5.	August 1999	Ruthenium	6
6.	July 2000	Ruthenium	1.53
7.	September 2000	Ruthenium	1.5
8.	November 2000	Eosin	3.2
9.	December 2000	Ruthenium	3.2
10.	January 2001	Metallochromic	0.3
11.	May 2001	Ruthenium	10
12.	May 2001	Bromopyrogallol red	0.8
13.	May 2001	Ruthenium	0.25
14.	October 2001	Ruthenium	0.8
15.	December 2001	Ruthenium	3.0
16.	February 2002	Ruthenium	2.7
17.	April 2002	Ruthenium	2.1
18.	July 2002	Ruthenium	6.0
19.	September 2002	Bromopyrogallol red and Pyrocatechol violet	1.4
20.	September 2002	Ruthenium	6
21.	September 2002	Ruthenium	3.7
22.	September 2002	Ruthenium	6.9
23.	September 2002	Ruthenium	0.5
24.	January 2003	Ruthenium	0.8
25.	April 2003	Rose Bengal	1.5
26.	October 2003	Fast green and Acridine Yellow	1.67
27.	November 2003	Ruthenium	2.7
28.	December 2003	Polythiocyanoglen conducting polymer	0.3

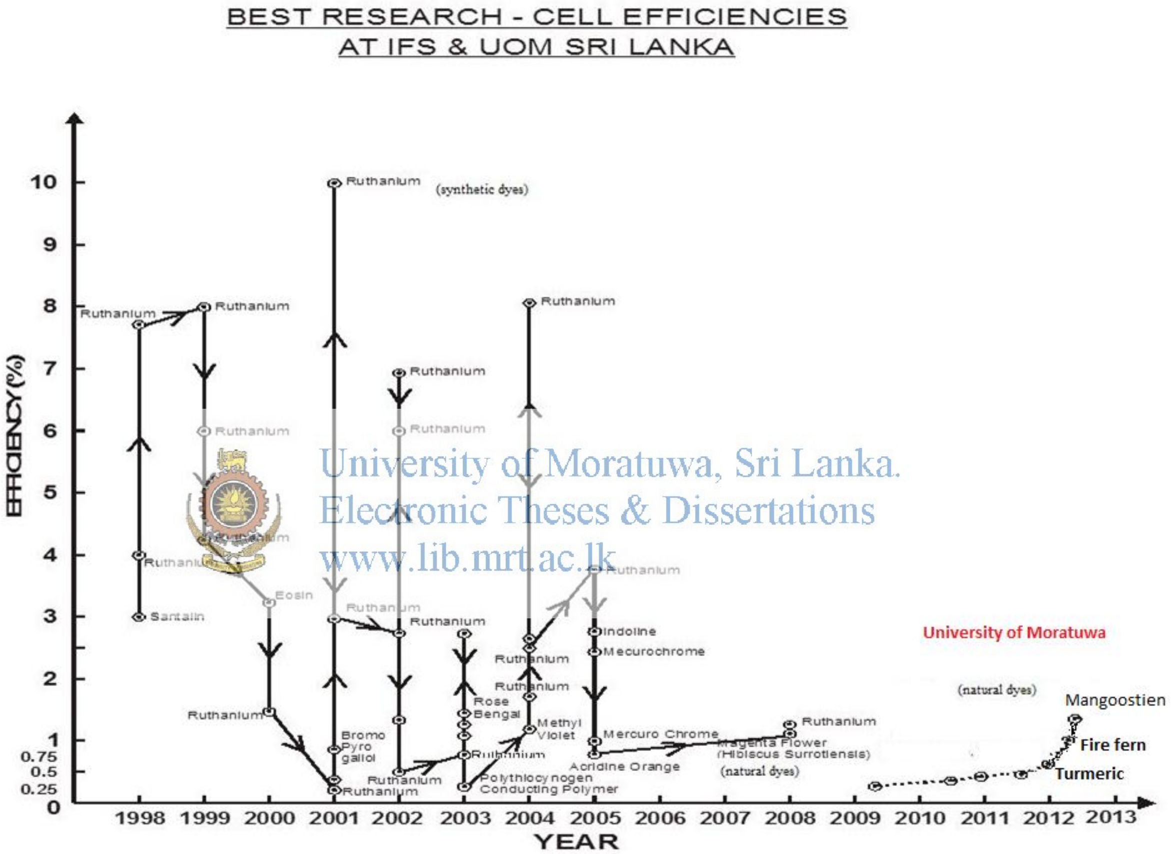
29.	April 2004	Methyl violet and Mercurochrome	1.37
30.	June 2004	Ruthenium	8.2
31.	June 2004	Fast green, Rhodomine and Acridine Yellow	1.67
32.	July 2004	Ruthenium	2.3
33.	December 2004	Methyl violet	1.4
34.	December 2004	Ruthenium	2.3
35.	January 2005	Ruthenium	3.7
36.	May 2005	Indoline	2.8
37.	June 2005	Acridine orange, Rhodomine B and Bromopyrogallol red	0.82
38.	June 2005	Mercurochrome	2.4
39.	June 2005	Mercurochrome	1.0
40.	July 2008	Hibiscus surottensis flower (natural dye)	1.14
41.	September 2008	Ruthenium	1.21

By University of Moratuwa Research Staff at IFS (Author)

1.	June 2009	Mangoostein (Natural dye) Turmeric (Natural dye)	0.111 0.210
2.	January 2010	Mangoostein (Natural dye) Turmeric (Natural dye)	0.165 0.223
3.	October 2010	Mangoostein (Natural dye) Turmeric (Natural dye	0.271 0.241
4.	February 2011	Mangoostein (Natural dye) Turmeric (Natural dye)	0.340 0.252
5.	December 2012	Mangoostein (Natural dye) Turmeric (Natural dye) Fire fern (Natural dye)	1.053 0.264 0.802

BEST RESEARCH – CELL EFFICIENCIES

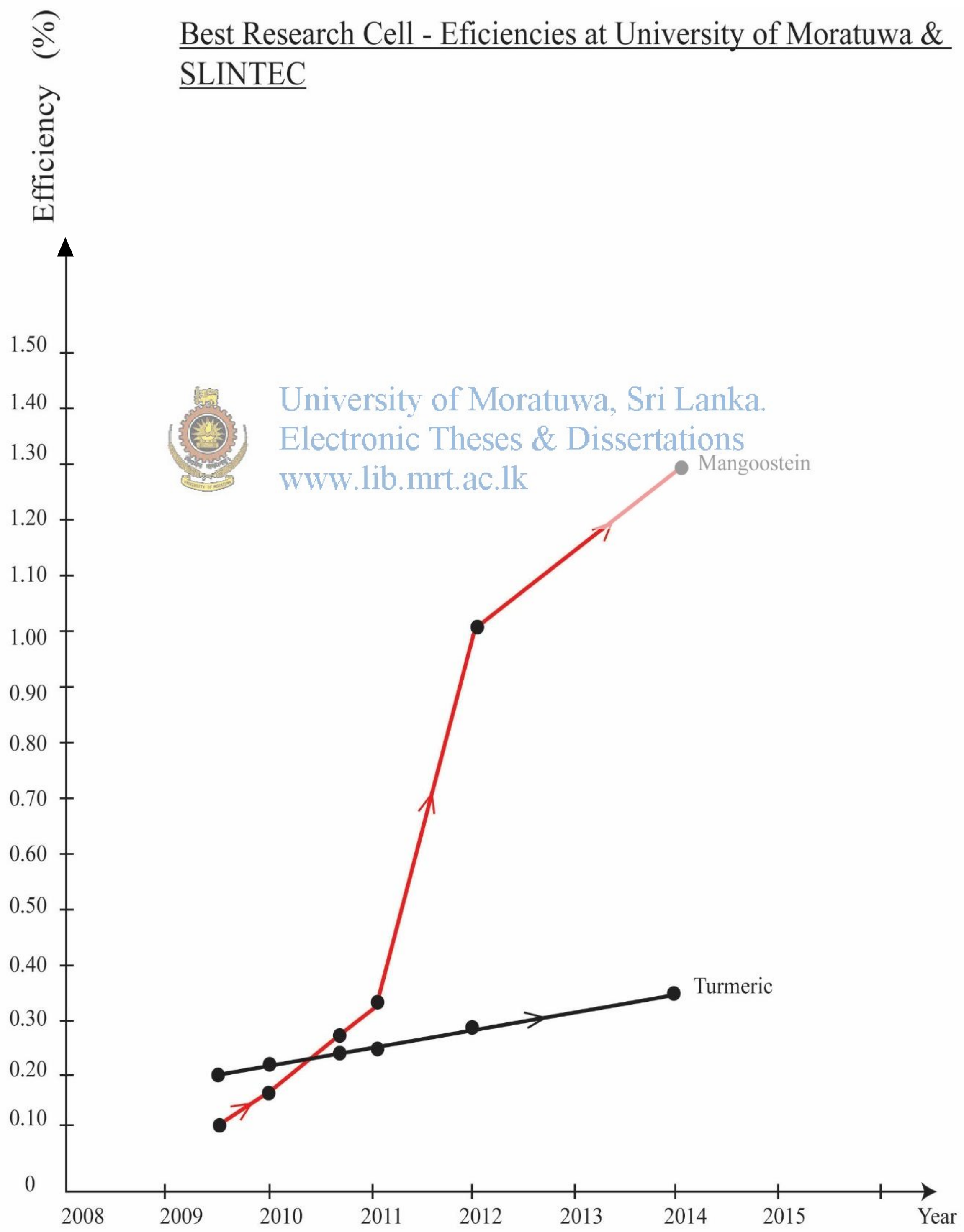
AT IFS AND UNIVERSITY OF MORATUWA , SRI LANKA



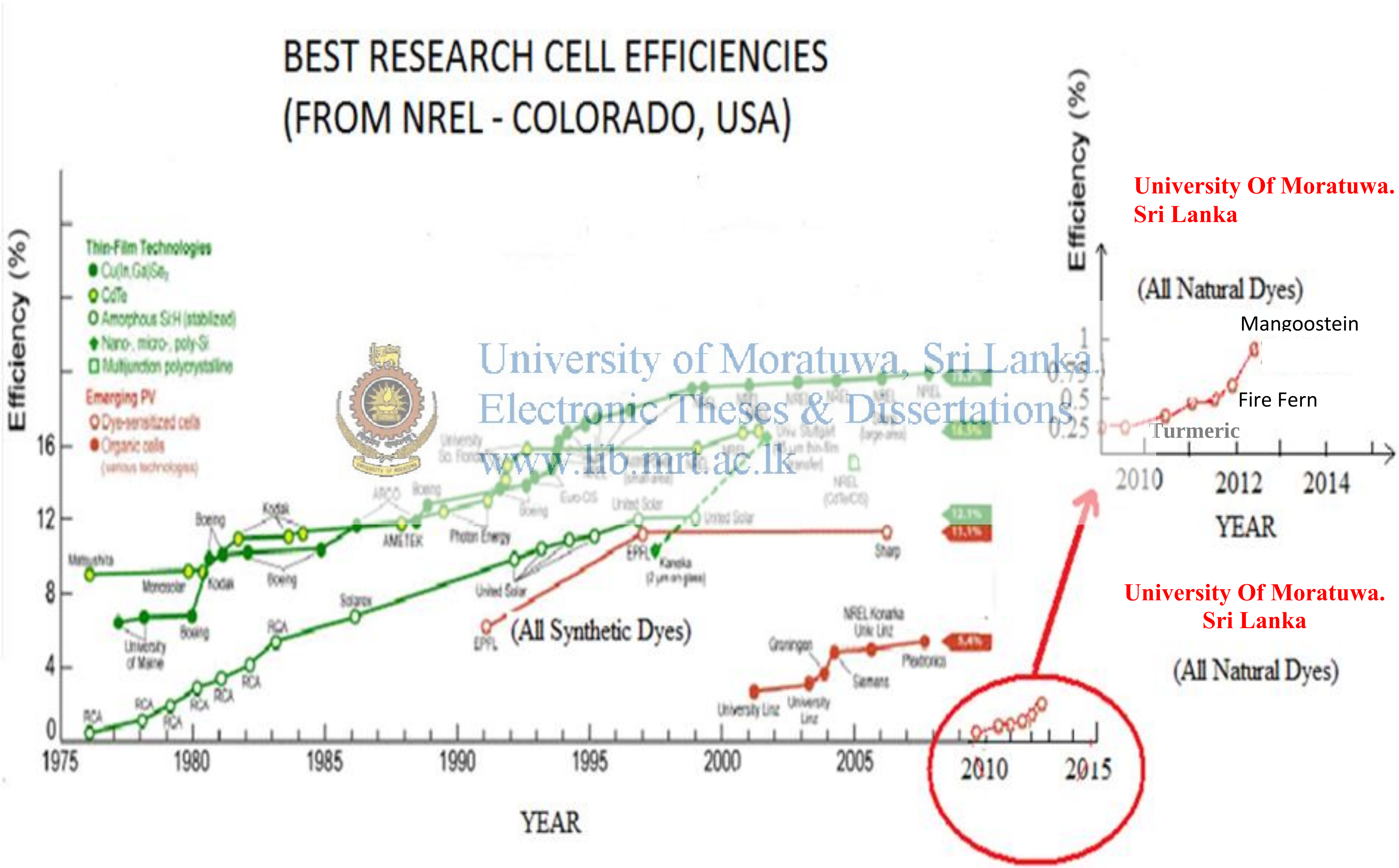
APPENDIX- G

BEST RESEARCH – CELL EFFICIENCIES

AT IFS AND UNIVERSITY OF MORATUWA , SRI LANKA

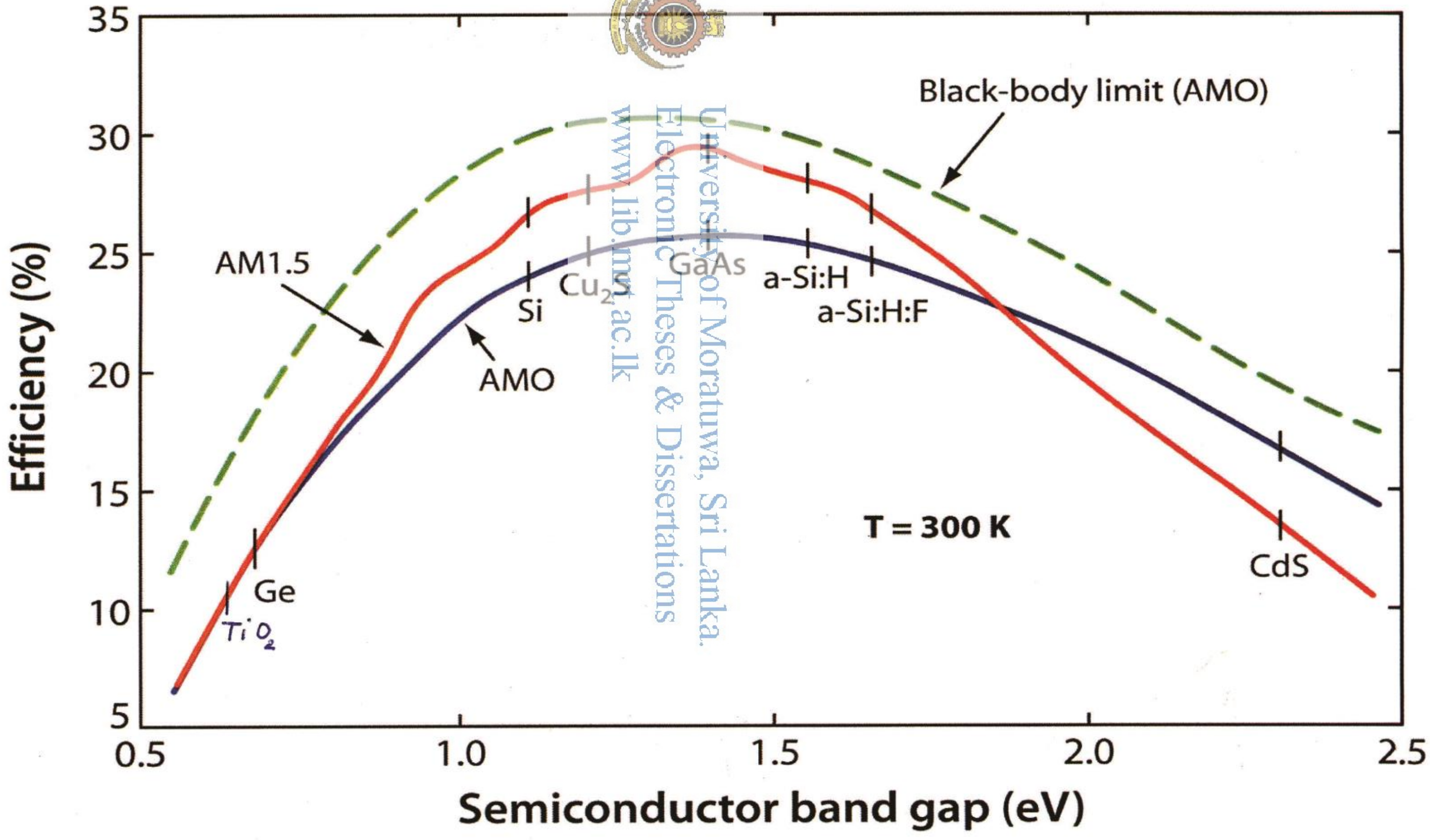


APPENDIX H

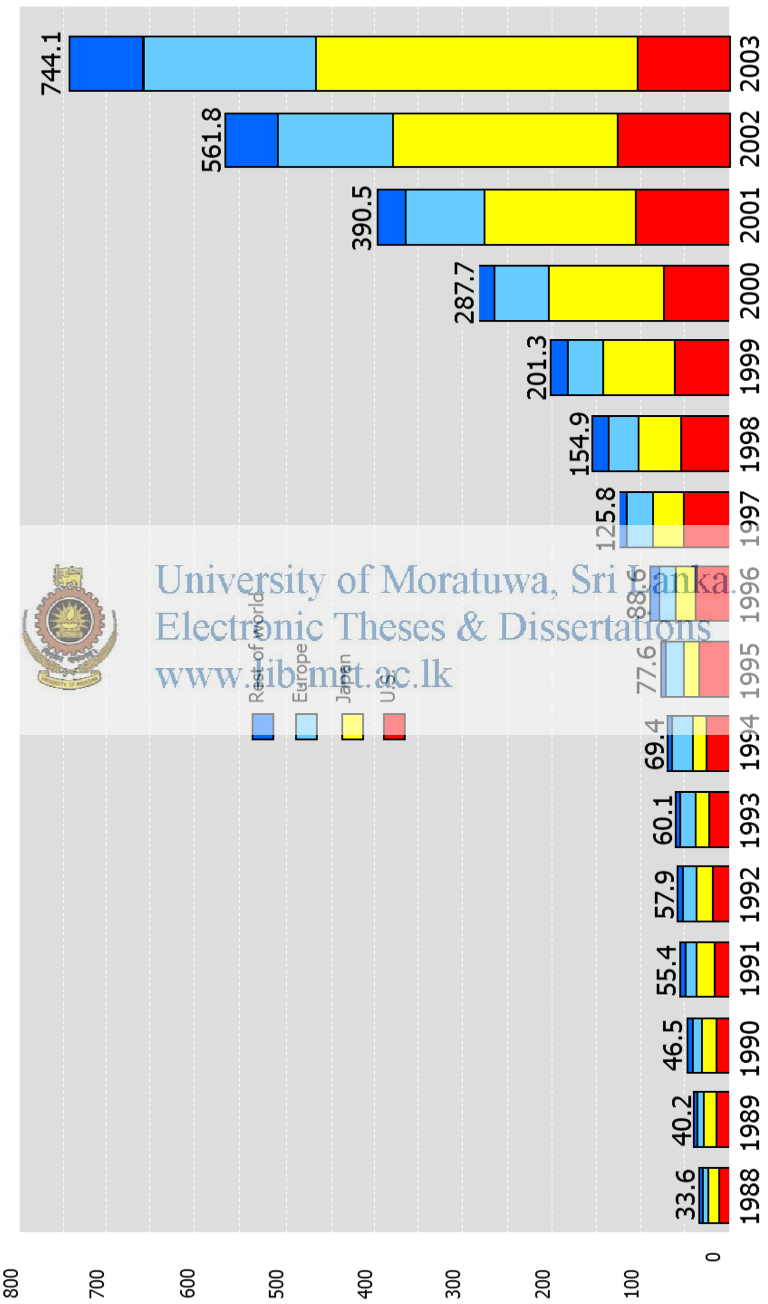

BEST RESEARCH CELL EFFICIENCIES
(FROM NREL - COLORADO, USA)
Efficiency (%)
Thin-Film Technologies
Emerging PV
Dye-sensitized cells
Organic cells
(All Synthetic Dyes)
YEAR
1975
1980
1985
1990
1995
2000
2005
2010
2015
University Of Moratuwa.
Sri Lanka
(All Natural Dyes)
Mangoostein
Fire Fern
Turmeric
2010
2012
2014
YEAR
University Of Moratuwa.
Sri Lanka
(All Natural Dyes)

APPENDIX I

BAND GAPS OF VARIOUS SOLAR CELL MATERIAL AND CONVERSION EFFICIENCIES OF VARIOUS TYPES OF SOLAR CELLS



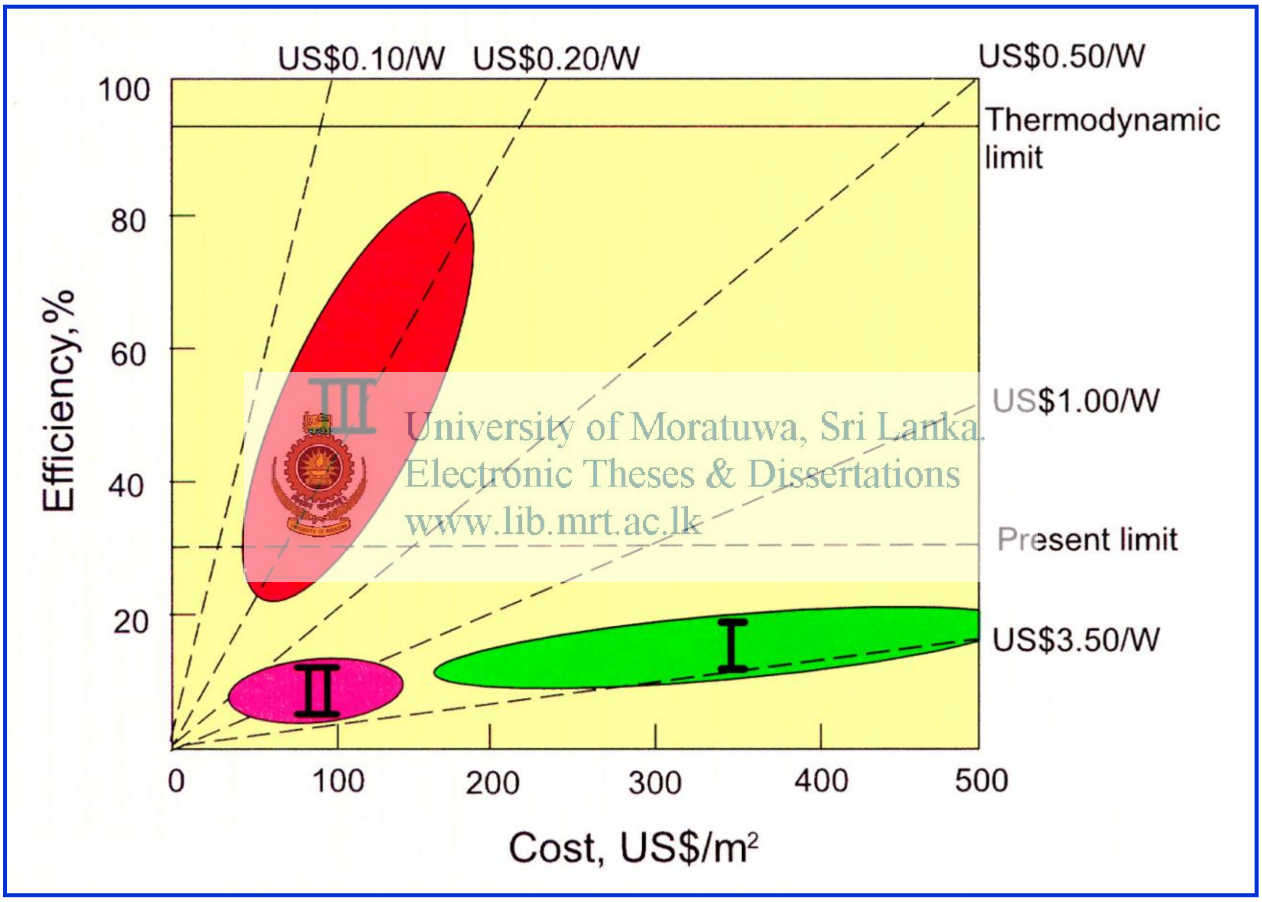
Commercialization & Market Potential of Solar PV's



Amount of solar photovoltaic systems accumulated in the world by major producers for period 1981 to 2003

PV Power Costs as Function of Cell Efficiency and Module Cost

EFFICIENCY VS COST FOR I, II AND III GENERATIONS OF SOLAR CELLS



For PV or PEC to provide the level of C-free energy required for electricity and fuel—power cost needs to be 2-3 cents/kWh ($0.40 – $0.60/W)

APPRENDIX - L

List of Major Solar PV Cell Manufacturing Companies in the World

1 Sustainable Technologies International, Queensbayan, NSW, Australia
2 BP Solar, Burstadt, Germany
3 BP Solar, Sydney NSW, Australia
4 Ersol Solar Energy AG, Germany, Wilhelms
5 Eni Power S.P.A. Australia
6 GE Energy, Atlanta Georgia U.S.A.
7 Pecell Technologies, Santa Babara California, U.S.A.
8 Global Solar Energy Inc, Arizona U.S.A.
9 Suntech, Betzville, Mayland U.S.A.
10 Yingili Green Energy, Baoding, Hebei, China
11 Isofotan, Madrid, Spain
12 UPV Solar, Coimbatore, Tamil Nadu, India
13 Kyocera Solar Corporation, San Diego, California, USA
14 Mitsubishi Electric, Chiyoda, Tokyo, Japan
15 Photowatt International, Hilboro, Oregon, U.S.A.
16 Q-Cell AG, Thalheim/Wolfen, Saxany, Germany
17 Schott Solar, Alyenau, Germany
18 Sanyo Electric Company, Shija, Japan
19 Sharp Corporation, Osaka, Japan
20 Solar World AG, Bonn, Germany
21 United Solar Ovonic LLC, Leiester, Leiestershire, U.K.
22 Dyesol, Queensbayan, NSW, Australia
23 Toshiba, Tokyo, Japan
24 Fuji Electric, Osaka, Tokyo, Japan
25 Nippon Electric, Chiyoda, Tokyo, Japan
26 Motech, Delaware, Florida, U.S.A.
27 Schott Solar, Albuguerque, NM, U.S.A.
28 Sanyo, Shija, Japan
29 Shell Solar, Colorado, U.S.A.
30 Unisolar, Michigan, U.S.A.
31 Company Greatcell, Lausanne, Switzerland
32 Greatcell Company, Wekdinweg, Netherlands
33 Company Mansolar, Pettan, Netherlands
34 Free Energy Europe, Hague, Netherlands
35 Solarian GmbH, Berlin, Germany
36 Ersol Solar AG Balion, Germany
37 Eurosolaro, Rome, Italy
38 Deutsche Solar, GmbH, Munich, Germany
39 Central Electronics, New Delhi, India
40 Bharat Heavy Electicals, Banglore, India
41 Euro Multisession, Mumbai, India
42 Microsol Power, Hydrabad, India
43 Biztech Power, Karachi, Pakistan
44 Solar Power Systems, Karachi, Pakistan
45 Solar Power, Rawlpindi, Pakistan
46 Gorosabel Solar, Mendro, Spain
47 Mandrajon Assembly, Gipuzkoa, Spain
48 Advanced Dicing Technologies, Hifa, Israel
49 Amcor Solar Energies Ltd, Ashod, Israel
50 Arava Power Company, Ketura, Israel
51 Bangkok Solar, Chachoengao, Thailand
52 Alpha Synergies, Bangkok, Thailand
53 Photovoltaic Manufacturing Company, Teheran, Iran
54 Canadian Solar, Ontario, Canada
55 Allesun Solar, Richmond, BC, Canada
56 Aquatech Solar, Auckland, New Zealand
57 Electro IO, Veniseux, France
58 Sharp Energia, Paris, France
59 Solaraire, Paris, France
60 SVS Sra, Brno, Czechoslovakia
61 SCR Energy, Radihastem, Czechoslovakia
62 G24 Innovations Ltd, Cardiff, Wales,

APPENDIX - M

Main Research Organizations and Established Companies in the world carrying out R& D on Dye-Sensitized Solar Cells

1. Georgia Institute of Technology, USA

Location : Georgia, Atlanta, USA

Research highlights: The centre for organic Photonics and Electronics (COPE) in the School of Electrical and Computer Engineering at Georgia Tech does research on improving efficiencies and design structures of light-weight organic solar cells. This centre works with the University Centre for Excellence in Photovoltaic (UCEP) for improving conventional silicon and organic solar cells. Led by Prof. Bernard Kippeler, COPE has designed cells using crystalline organic films called Pentacene that results more efficient and lightweight solar cells.

2. Korea Institute of Energy Research

Location: Daejeon, South Korea

Research Highlights: The Institute specializes in energy research and works on developing new technologies supporting energy policies. It has carried out research on improving organic solar cell technology with TiO2, and integrating this with other solar based technologies.

3. Center for Photonics and Optoelectronic Materials.

Location: New Jersey, USA.

Research highlights: This center, affiliated with the Department of Electrical Engineering does research on technologies for making organic solar cells more efficient and cheaper. This Center has recently developed techniques for manufacturing organic solar cells at higher efficiencies about 5%.

4. United States Air Force Research Laboratories

Location : Ohio, USA

Research highlights: The scientists and researchers at the materials and manufacturing Directorate have been involved in developing advanced, flexible organic based solar cells. The research has focused on all-polymer and organic material approach, and Dye sensitized organic and inorganic material hybrid approach. This research is expected to yield versatile used of PV, especially for military operations and applications Present studies have resulted in efficiencies of over 10%.

Established Companies producing Die-Sensitized Solar Cells

5. Sustainable Technologies International Dyesol Australia Pty Ltd.
Location: Queenbeyar, NSW, Australia

Company Profile: This company was the world's first company to start commercial production of dye sensitized solar cells which are based on organic cell technology. It also produces photovoltaic components using nanotechnology. The company started its pilot production line in 2001 and had an annual production capacity of .5 MW for organic solar cells by 2008. This Company is now owned by Dyesol Australia Pty Ltd.

6. Global Photonic Energy Corporation
Location : New Jersey, U.S.A.

Company Profile: Global photonics is a renewable energy technology development company. It has also carried out research on enveloping technologies for producing organic solar cells. The company targets designers and product innovators to accelerate the development of this technology.

7. General Electric Global Research Company
Location: GE Offices worldwide

Company Profile: This company has a research unit at GE works on developing flexible substrates without silicon and optimized organic solar cells for energy conversion. The focus is on making use of technology and OLED device architecture in photovoltaic technology. It also develops roll - to - roll organic plastic sheets that can substitute conventional silicon panels and be used in a variety of applications.

8. Toshiba Research Europe Ltd.
Location : Cambridge, U.K.

Company Profile: Toshiba Company research centre works on developing organic solar cells, and has developed technologies that generate organic solar cells with efficiencies around 7%, with higher lifetimes. The centre has produced a technique for manufacturing plastic based solar cells using dyes suitable for varieties of applications.

9. Siemens Research and Development
Location : Germany

Company Profile: The Siemens Research group of this company works on developing efficient printed organic solar cells that can be scaled up for commercial use. The efficiencies of the cells developed exceed 5%, more than regular levels of commercial cell production. They are also lightweight and flexible. This technology has been sold to companies like Konarka.

10. Konarka Technologies Inc.
Location: Lowell, Masschusetts, USA.

Company Profile: Konarka Technologies Inc has worked on developing technologies for commercial production of low-cost cells on flexible material, with a focus on combining organic and nanotechnologies and polymer electronics. The company has had US$ 32 million financing by various investor agencies since 2001, and acquired the organic solar cell research group at Siemens in September 2005. Pilot - Scale production of organic solar cells began in 2005 and production is expected to scale up to commercial levels in 2009 / 2010. The Company diversified into manufacturing photovoltaic material adaptable for various applications, like spray-on plastic photovoltaic panels, solar fabric that generate power etc.

11. Solar AMP LIC
Location: Raleigh, North Carolina, U.S.A.

Company Profile: This company focuses on research and development of renewable technologies, and organic photovoltaic components. As part of a recent joint effort with BP, the start-up company has started to conduct test for developing commercially viable organic molecular based cells without using dye-sensitized solar cells with efficiencies targeted at 10-15% with lifetimes of 25 years.

12. Greatcell Company
Location: Lausanne, Switzerland

Company Profile: This company focuses on dye - sensitized solar cells using organic technology., It was brought by Tulloch Management Pty Ltd. which also owns sustainable Technologies International (STI) and Dyesol Australia Pty Ltd., but carried out research o

n organic solar cells, and assembles STI's outdoor facade modules.

13. AIXTRON AG
Location: Aachen,Germany

Company Profile: AIXTRON is a manufacture and supplier of equipment for compound semiconductor devices. In continuation of its Organic Vapour Phase Deposition (OVPD) business, the Company has expanded research on organic solar cells in association with other companies, and is sponsored by the German Company Halin Meitner-Institute HMI.

APPENDIX – M

Basin Trials of Organic / DSSC Powered Catamaran Boat


SOLAR CELL POWERED BOAT
SOORIYA – C 120


ORGANIC SOLAR CELL POWERED BOAT
SOORIYA – C 120


P475


ORGANIC SOLAR CELL POWERED BOAT
SOORIYA — C 120


SOLAR CELL POWERED BOAT
SOORIYA – C 120


SOORIYA – C 120

Design and Development of PV – DSSC Devices and Systems at University of Moratuwa

Herbert Arnold Gmbh, Germany – Electric Oven 440Volts, 3Phase for Spray Pyrolysis of FTO Glasses at 580°C

Spray Pyrolysis of FTO Glasses at 580°C

Preparation of FTO Glasses for Catamaran Boat

Design & Development of DSSC Operated Battery Charger for Mobile Phones, iPods etc.


Spike is concealed inside tube.

Prototype DSSC – BIPV Window Panels for High – Rise Buildings

DSSC Solar Panel for Catamaran Boat

Design & Development of Electrically Operated Natural Dye Extraction Unit

Portable DSSC Testing Spin Coating Machine