Paints with Ionanofluids as Pigments for Improvement of Heat Transfer on Architectural and Heat Exchanger Surfaces

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Portugal is one of the leading countries in renewable energies. Thermal solar energy is relatively low technology compared to photovoltaic systems; nevertheless these systems are important in countries with long periods of strong sunlight. The climate of our country makes the investment in solar energy a priority. In these applications the incident solar radiation reaches a panel surface and is converted to heat, which will be exchanged to warm domestic and/or industrial water. Thermal energy represents a high energy budget, usually produced from electricity or fuel burning and therefore it is important to increase the efficiency of thermal conversion of solar energy. A solar collector consists of a metallic box that supports the absorptive plate, metallic pipes used in the heat transfer to the hot fluid, insulation and a transparent surface [1]. The absorptive plate must be covered with a spectrally selective surface, in order to be efficient in the photothermal conversion. These surfaces can be covered by paint [2-4], whose application has the objective to decorate and/or to protect the substrate and to optimize its function. These paints usually have in their composition dark pigments, to increase energy absorption. These pigments are nanopowders that comprise metals and their oxides, fullerenes and carbon nanotubes (CNT) [5,6].

Previously we have reported good preliminary results with CNT's suspended in ionic liquids to enhance the photothermal performance of the collector. It was verified that the addition of IoNanofluids (Bucky gels) increases the spectral selectivity of the paint base, improving the coating efficiencies. These studies show that these materials are promising for their application in low VOC coatings for heat transfer [7]. Application to the conversion of solar energy in thermal energy is under way. Our work has now followed with the research of pigments from natural sources (plants and animal residues). After the accomplishment of the necessary tests, we foresee the existence of a new product with a high energy performance, the substitution of some currently dangerous products for the other more innocuous, and simultaneously the possibility of application of the new paint in the camouflage/improvement of the landscape, superior to the existing paints in the market. In the present paper we also report preliminary results with sensors made from thin film technology to be easily adapted to commercially available solar collectors, to accurately measure in-situ thermophysical properties of heat transfer fluids.

1. Solar térmico – Manual sobre tecnologias, projecto e instalação – Project GREENPRO (2004)
2. Orel, Zorica Crnjak; "Characterization of high-temperature-resistant spectrally selective paints for solar absorbers"; Solar Energy Materials & Solar Cells 57; 291- 301 (1999)
3. Orel, Zorica Crnjak; Gunde, Marta Klanjšek; "Spectrally selective paint coatings: preparation and characterization"; Solar Energy Materials & Solar Cells 68; 337-357 (2001)
4. Orel, Zorica Crnjak; Gunde, Marta Klanjšek; Hutchins, M.G.; "Spectrally selective solar absorbers in different non-black colours"; Solar Energy Materials & Solar Cells 85; 41-50 (2005)
5. Rao, C. N. R.; Müller, A.; Cheetham, A. K. (Editors); "The chemistry of nanomaterials – synthesis, properties and applications" WILEY-VCH (2004)
6. Reich, S.; Thomsen, C.; Maultzsch, J.; "Carbon nanotubes – basic concepts and physical properties" WILEY-VCH (2004)

7. Vieira, S., MSc Thesis “Funcionalização de nanomateriais para aplicações em conversão térmica de energia solar”, MSc Thesis, Faculty of Sciences, University of Lisbon (2008)