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Synthesis of Al_2O_3-SiO_2 core shell nanomaterials for development of stable nanofluids for thermal energy storage applications

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Nowadays, nanomaterials have great revolution for improving the efficiency of different types of renewable energies, which have been identified as a unique source to fulfil the present and future energy demand as well as to contribute to global warming problem. With this regard, concentrated solar power (CSP) technology was considered as a promising solution due to its higher dispatchability thanks to the incorporation of a cost-effective thermal energy storage (TES) system. Currently, the TES system is based on the two-tank-storage technology by using the binary $NaNO_3$-KNO_3 (60:40 wt.%) molten salt, so-called solar salt, as storage media. In the last years, the development of nanofluids, by the addition of minor percentage of nanoparticles to base salt, with enhanced thermophysical properties was investigated. Although nanofluids with enhanced heat capacity and thermal conductivity were achieved when SiO_2 and Al_2O_3 nanoparticles were used, their stability still not yet demonstrated due to the separation with time of nanoparticles from the salt. However, the experiment work made in our facilities demonstrated different behaviours of these nanomaterials where a settle down of SiO_2 nanoparticles and a floating of Al_2O_3 nanoparticles were observed, which may due to the density difference between liquid molecules and nanoparticles. However, the development of advanced mixed nanoparticles becomes of high importance in order to improve the nanofluid stability. The present research work is focused on development of stable nanofluids based on inorganic salts, by the addition of advanced Al_2O_3-SiO_2 core shell nanomaterials with different densities obtained by changing the alumina to silica ratio. The formation of the core shell structure was initially confirmed by TEM and FTIR analyses. The nanofluids thermophysical properties enhancements were studied by DSC, LFA and rheometer techniques. Finally, their stability was investigated by TGA and long-term stability tests in the furnace.

Speaker Biography

Udayashankar Nithiyanantham is pursuing his PhD degree in Physics at University of Basque Country (UPV/EHU). The research work of his PhD, which is under development at CIC Energigune, is focused on to the synthesis, characterization of inorganic molten salts based nanofluids and their potential applications in medium and high temperatures thermal energy storage applications.

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