The effect of pH value on particle agglomeration and the radiative properties of nanoparticle suspensions

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Nanofluids, or nanoparticle suspensions, have been used extensively to improve thermal efficiency of different thermal systems. Because of their unique thermo-optical properties, which can be tailored by using different type and size particles, they can be adapted as effective working media in solar thermal collectors for photothermal energy conversion in addition to other thermal applications. However, particle agglomeration in nanosuspensions remains one of the most important challenges for their long term and reliable use. Also, particle agglomeration can have significant effect on the radiative properties of such fluids especially if their use requires selective absorption of radiative flux, such as in solar concentrating power systems.

The purpose of the present study is to investigate the effect of pH value on particle agglomeration. For this purpose, the optical and radiative properties of two types of nanoparticles (Al\textsubscript{2}O\textsubscript{3} and TiO\textsubscript{2}) are investigated to determine the effects of pH value on agglomeration. First, using a dynamic light scattering (DLS) technique, particle size distribution and average particle agglomerate size are measured. Also, the radiative properties (scattering and extinction coefficients) are experimentally determined using an UV/Visible spectroscopy technique. The comparisons of these results with different light-scattering model predictions are used to demark the dependent/independent scattering regime boundaries of different nanosuspensions. The ultimate objective of this research is to produce nanosuspensions with different average particle agglomerate sizes and size distributions to enhance and tailor their spectrally radiative properties.

Preferred mode of presentation: Oral