Absorption and Scattering Behaviour of Nanofluids in the Visible Range

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The use of plasmonic Nanofluids in photothermal applications, such as solar thermal receivers, is a strong subject in current research (see for example the review paper by Mahian et al. in Int. J. of Heat and Mass Transfer, 2013). However, the question about the amount of absorbed energy is of great concern for all of these applications. The calculations are often simplified by neglecting scattering, which in fact becomes important for higher volume fractions, for larger particles or agglomerates. Scattering reduces the absorbed radiation, i.e. usable heat, in the absorber. Thus, in many applications, scattering has to be considered as a loss. In this paper, calculations based on the Mie theory are shown and validated with absorption measurements using an integrating sphere and a UV-Vis Photospectrometer. The calculations show the influence of particle size distributions on the absorption spectra. In order to describe the influence of scattering, besides the absorptions spectra, scattering spectra are calculated and compared with measurement results. Furthermore, the influence of the refractive indices on the absorption behaviour is discussed to show prospects of different materials for solar thermal applications. Using the refractive indices of a medium, the optical behaviour can be predicted. From these calculations, information can be drawn, whether a certain nanofluid can be utilized in absorbers or in applications where high scattering rates are favoured, such as pigments.