

## **Photothermal effect of modulating laser irradiation on the thermal diffusivity of Al<sub>2</sub>O<sub>3</sub> nanofluids**

### **ABSTRACT**

Modulated continuous wave (CW) lasers cause photothermal effect that leads to rapid optical absorption and generation of thermal waves around the irradiated nanostructures. In this work, we examined the effect of modulated CW laser irradiation on the particle fragmentation process to enhance the thermal diffusivity of nanofluids. A facile and cost-effective diode laser was applied to reduce the agglomerated size of Al<sub>2</sub>O<sub>3</sub> nanoparticles in deionized water. The thermal wave generation, which was determined by the modulated frequency of the laser beam and the optical and thermal properties of the nanofluid, is also briefly discussed and summarized. The influence of laser irradiation time on nanoparticle sizes and their size distribution was determined by dynamic light scattering and transmission electron microscopy. The thermal diffusivity of the nanofluid was measured using the photopyroelectric method. The data obtained showed that the modulated laser irradiation caused the partial fragmentation of some agglomerated particles in the colloids, with an average diameter close to the original particle size, as indicated by a narrow distribution size. The reduction in the agglomerated size of the particles also resulted in an enhancement of the thermal diffusivity values, from  $1.444 \times 10^{-3}$  to  $1.498 \times 10^{-3}$  cm<sup>2</sup>/s in 0 to 30 min of irradiation time. This work brings new possibilities and insight into the fragmentation of agglomerated nanomaterials based on the photothermal study.

**Keyword:** Photothermal effect; Continuous wave laser; Fragmentation of nanoparticles; Thermal diffusivity of nanofluids