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Analysis of the state of carbon nanotubes solution based on dynamic speckles

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Nanofluid is a colloidal solution of particles with a size of (0.1-100) nm in a liquid solvent. Due to their unique physicochemical properties, nanofluids are considered promising materials for electronics, energy, pharmaceuticals, etc. The great value of the surface energy of nanoparticles contributes to their tendency to aggregation. Therefore, nanofluids are very unstable. Their properties are easily changed and are highly dependent on external influences. The development of technologies for obtaining stable nanofluids requires special control methods.

In this work, we consider the possibility of using dynamic speckle analysis to control the state of an aqueous solution of carbon nanotubes. We used an optical scheme and a signal processing algorithm to analyze dynamic speckles in the scattering of laser radiation in a weakly inhomogeneous medium, which were previously used for pure liquids.

Aqueous suspensions of nanotubes were prepared in various concentrations (C < 1%) using ultrasonic treatment. A high-speed USB camera was used to record dynamic speckles from the scattering of radiation from a He-Ne laser by nanoparticles. We calculated the autocorrelation function of dynamic speckle every 2 s and investigated the dynamics of the behavior of the decay rate of the ACF over a long time (~1 h). The increase in the decay rate over time reflects the coarsening of the nanoparticles due to aggregation.

We have recorded different types of behavior of carbon nanotubes suspension of depending on concentration, ultrasonic treatment time and storage duration. We also found that some substances are able to stabilize the suspension.

Topics

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