Optothermoacoustic Processes in Highly Diluted Suspensions of Gold Nanoparticles

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Optoacoustic (OA) sensor was designed, fabricated and used used to detect spherical gold nanoparticles (NPs) in suspensions at the level of up to a single particle. The sensor operated in the backward mode was designed to measure signals from microscopic volumes of nanoparticulate suspensions. Thermal nonlinearity was observed in the course of OA conversion. The irradiation of the microvolume of gold nanoparticles gives rise to a multitude of thermomechanical processes, including superheating of NPs, thermal diffusion from nanoparticles to the host liquid (water), and formation of vapor nanobubbles. As a result, a specific acoustic signal is produced exhibiting nonlinear behavior with respect to laser pulse energy. The optoacoustic profile of the laser-induced signal generated in highly diluted suspensions for the case of 1D-thin layer geometry was examined thureby providing a basis for a method of nanoparticle detection with high sensitivity.