Stimulated Low-Frequency Raman Scattering in Nanoparticles Suspensions

Anna Kudryavtseva [C, S] and Nikolai Tcherniega
P.N.Lebedev Physical Institute of the Russian Academy of Sciences, Optical Division, Moscow, Russia
akudr@sci.lebedev.ru

Recently we observed new type of stimulated scattering of light in nanostructured materials: Stimulated Low-Frequency Raman Scattering (SLFRS). It is a result of laser pulses interaction with acoustic vibrations of the structure elements, lying in gigahertz range. First SLFSR was observed in synthetic opal matrices and in nanocomposites on their base. Three-dimensional synthetic opal matrices are composed of close-packed silica spheres arranged in face-centered cubic lattice. Due to the submicron sphere size (200-300 nm) opal matrices exhibit optical stop bands in the visible spectral range for modes propagating in given direction. Opal matrices infiltrated with nonlinear liquids are almost transparent, which gives possibility to observe scattered light both in backward and in forward direction. Frequency shifts of the components have been shown to correspond to the eigenvalues of the silica spheres vibrations frequencies. Later we found out that SLFRS may be excited in less ordered systems, for instance, nanostructured thin films. In the present work we show that SLFRS may be observed in random materials, for instance, suspensions of nanoparticles: in nanodiamonds suspension in water and ZnS suspension. Frequency shift of the scattered light has been measured and dimensions of nanoparticles have been evaluated with the help of the dynamic light scattering method. In all materials investigated SLFRS propagates in narrow beams both in forward and backward direction. The beams divergence and line-width of the scattered light are near to the corresponding values of the exciting laser light. Conversion efficiency of the SLFRS is very high (up to 60 %).