Multiple Stokes and anti-Stokes components generation by biharmonic pumping via stimulated low-frequency Raman scattering

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The process of high efficiency coherent acoustic excitation of the submicron particles system by biharmonic pumping is investigated. This excitation leads to effective multiple Stokes and anti-Stokes high-order components generation. This process can be used for effective generation of the coherent electromagnetic radiation with tunable spectral distribution consisting of several spectral lines separated by a constant frequency spacing of several GHz.

Any spatially limited object, including submicron and nanoscale ones, constantly undergoes thermal vibrations. The set of acoustic eigen frequencies of any object with which it oscillates is determined by its morphology, as well as by the elastic characteristics of its environment. Some of these acoustic excitations are Raman active and can manifest themselves in low-frequency Raman scattering [1] (LFRS) or in stimulated low frequency Raman scattering [2] (SLFRS). Biharmonic pumping is electromagnetic radiation whose spectrum consists of two spectral lines can be used for effective for effective impact on the system of particles in the case of the matching the particles acoustic eigenfrequencies with the frequency shift of biharmonic radiation by analogy with coherently driven molecular vibrations [3]. This process can lead to multiple Stokes and anti-Stokes high-order components generation.

The effect of multiple Stokes and anti-Stokes components generation by biharmonic pumping in nanosecond temporal range was demonstrated in a number of dielectric, semiconductor and metallic submicron particles systems. The effective generation of six equally shifted spectral components was realized. The possible application of the observed phenomenon for spectroscopy of the nanoscale and submicron systems is discussed.

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