Laser-induced coalescence and agglomeration of noble metal nanoparticles embedded in a polymer matrix

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During the deposition process, the size and shape of metal nanoparticles embedded in a polymer matrix is determined, and at room temperature, the polymer matrix supplies a sufficient long-time stabilization of the nanostructure. The absorption of laser light and the resulting incorporation of thermal energy can dramatically change the size and shape distribution of the embedded particles and their optical properties. Laser irradiation causes the activation of diffusion processes of metal atoms, which occurs at temperatures far below the melting point of the metals. The material transport is driven by the free surface energy of the nanoparticles and is associated with lattice defects and grain boundaries. By irradiating embedded nanoparticle assemblies with linearly polarized, ultrashort laser pulses, the diffusion processes are influenced by interferences. As a result, parallel arranged line structures of embedded gold or silver nanoparticles, and therefore anisotropic optical properties can be achieved inside the laser irradiated sample region. Otherwise, because of their high absorption, agglomeration and melting of nanoparticles can be induced locally. In this case, the incorporated energy is high enough for laser welding of polymer foils.