Deposition of nanoparticle metal films using nanosecond and femtosecond lasers

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Pulsed laser deposition (PLD) is a relatively simple technique for the preparation of metal nanoparticle (NP) films which are free from chemical contamination. I will describe the results of some recent work on PLD of metal NP films using both between nanosecond (*ns*) and femtosecond (*fs*) lasers. We have studied the dynamics of both the plasma and nanoparticle ablation plumes using Langmuir probe, optical emission spectroscopy and time-resolved optical absorption. In *ns* PLD ablation plume is strongly ionised and the NPs form by surface diffusion on the substrate. In *fs* PLD a smaller fraction of the ablated material is removed as a plasma plume moving at ~10^6 cm s^{-2}, and a larger fraction leaves the target as a hot nanoparticle mist moving at ~2×10^4 cm s^{-2}. We describe both the optical emission and absorption properties of the nanoparticle mist by taking account of the wavelength dependence of the nanoparticle emissivity. The energy efficiencies of *ns* and *fs* laser ablation were measured and the ablation plume dynamics were compared. For silver NP distributions were measured using transmission electron mcroscopy; in both cases the mean particle size was found to increase as the eqivalent solid-density thickness of the depsoit increased. The films displayed the expected surface plasmon resonance in the visible optical spectrum. We have benchmarked the SERS performance of these sliver NP films against a commerical substrate.