Plasma deposition of dielectric/metal nanocomposite layers exhibiting surface plasmon resonance effects.

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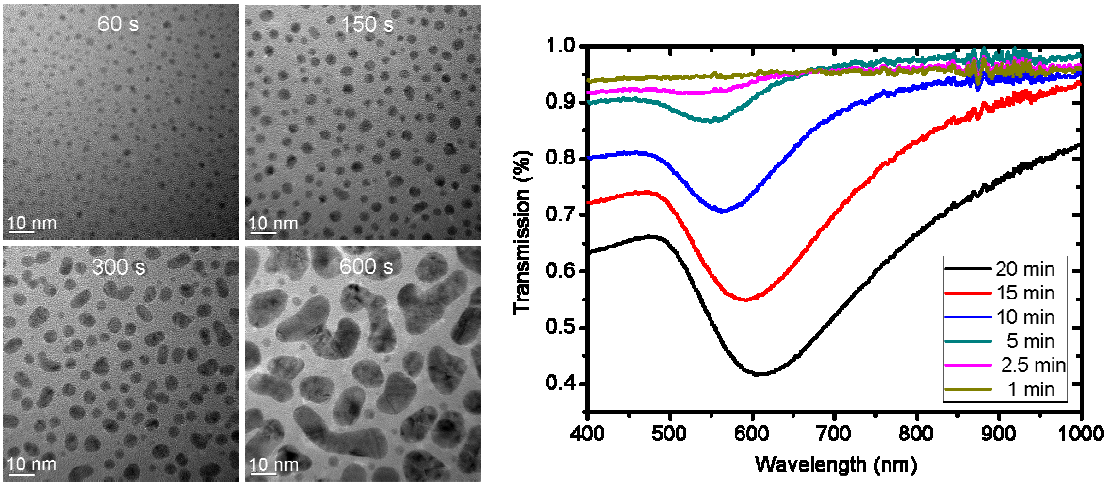
Abstract:

This work addresses nanocomposite (NC) layers deposited by means of plasma- aided tools, and exhibiting a localized surface plasmon resonance (SPRs)- induced absorption in a specific wavelength range. The presence of an SPR- induced absorption allows to obtain specific colours of nanocomposite layers only dependent on the light absorption on the metal clusters. This eventually allows the development of uniformly coloured 3D geometries, therefore, eliminating the disadvantage of working on interference-based colour generation, poorly controllable on 3D geometries due to a lack of thickness uniformity. In this contribution, hybrid materials consisting of metal nanoparticles dispersed in a dielectric matrix are presented, where an Expanding Thermal Plasma CVD system is used for the deposition of the inorganic matrix (SiO2-like layers) from hexamethyldisiloxane/oxygen mixtures, and RF magnetron sputtering is applied for the metallic clusters (gold). The optical properties of the NC layers have been investigated by UV-VIS-NIR variable angle spectroscopic ellipsometry and by optical transmission. Rutherford backscattering/ Elastic Recoil Detection and InfraRed absorption spectroscopy were used for determine the film density and chemical composition, respectively. Transmission Electron Microscope observation revealed the formation of gold nanoparticles uniformly distributed in SiO_2-like layers (Figure 1a) exhibiting deep red to blue coloured coatings with the shift of the SPRs band to higher wavelength with an increase in the size of nanoparticles and metal filling factor (Figure 1b).



(A) (B)

Figure 1: TEM images (A) and the transmission spectra (B) of Au/SiO_2-like nanocomposite layers deposited at various time of deposition: RF-power = 50 W, Ar flow = 30 sccs, Arc current = 25 A, $P_{reactor}$ = 12 Pa.