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Plasma deposition of functional nanocomposites

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Nanocomposite films consisting of metal nanoparticles in a dielectric organic or ceramic matrix have unique functional properties with hosts of applications [1]. The present talk demonstrates how plasma and other vapor phase deposition techniques can be employed for tailoring the nanostructure and the resulting properties. Vapor phase deposition, inter alia, allows excellent control of the metallic filling factor and its depth profile as well as the incorporation of alloy nanoparticles with well-defined composition. The metallic nanoparticles typically form via self-organization during co-deposition of the metallic and matrix components due to the high cohesive energy of the metals and the low metal-matrix interaction energy. Various methods such as sputtering, plasma polymerization, and evaporation have been applied for the deposition of the matrix component, while the metallic component has mostly been sputter-deposited or evaporated. Moreover, gas aggregation cluster sources were utilized to obtain independent control of filling factor and size of the embedded nanoparticles [2,3]. Nanostructure formation was also studied by computer simulations [4]. In most applications, a high filling factor close to the percolation threshold is essential because the functional properties often require short range interaction between nanoparticles. Examples range from plasmonic composites through sensors to biocompatible antibacterial coatings with tailored release rate [1,5].

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