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Is nanoparticles sputtering at atmospheric pressure a solution to make nanostructured thin films?

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Suspension containing nanoparticles (NPs) are currently used as precursor for AP-PECVD (Atmospheric Pressure-Plasma Enhanced Chemical Vapor Deposition) of nanocomposite. The NPs are suspended in a fluid (usually a liquid) and injected directly into the discharge. In the thin film coating, NPs are embedded into the matrix made by polymerization of the reactive precursors. If interesting results are obtained, the drawback of the method is that NPs aggregation is largely determined by the suspension properties and NPs have to be carefully functionalized to get a stable suspension and to avoid the formation of large aggregates defined by the nebulization droplet size. The aim of this work is to develop a different process to make nanocomposite by AP-PECVD of NPs. It is based on the sputtering of a target made from the NPs, 25nm diameter titanium dioxide (TiO_2) in this work. The discharge is a dual frequency dielectric barrier discharge made in Ar/NH3 Penning mixture. A radiofrequency voltage is used to initiate the discharge and a low frequency is added to control the transport of positive ions to the cathode and the transport of negatively charged NPs from the cathode to the gas bulk.
The effect of the amplitude and frequency of the two voltages on the presence of NPS in the plasma phase is measured by laser diffusion and correlated to the plasma emission of NH and Argon. First the feasibility of NPs target sputtering in a DBD is shown. Second the morphology of the coating made by the NPs is observed by SEM and correlated to the plasma observations. Numerical modeling of the NPs transport is also used to better understand the mechanism controlling the sputtering and the transport of the NPs to the surface. We have evaluate that two forces will predominate in this transport : the electric force from the low frequency excitation and the diffusion of NPs due to the concentration gradient.

Keywords
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