Nanostructured coatings on large surfaces

To cite this version:

HAL Id: cea-02340842
https://hal-cea.archives-ouvertes.fr/cea-02340842
Submitted on 31 Oct 2019

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L’archive ouverte pluridisciplinaire HAL, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d’enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.
We present here an original safe-by-design method for the elaboration of nanostructured films composed of nanoparticles embedded in a matrix. This versatile single step process operates under vacuum by combining the jet of nanoparticles technology with classical magnetron sputtering. It is then possible to choose independently the chemical nature of nanoparticles and matrix. Moreover, it is possible to use any source of nanoparticles in the gas phase. For example, nanoparticles can be synthesized in-situ by laser driven pyrolysis [1]. An atomizer that produces aerosol from colloidal suspension of previously synthesized nanoparticles can also be used. After the achievement of the proof of concept with a laboratory apparatus, we have developed a new prototype for synthesizing homogenous nanocomposites thin film on surfaces that are large enough to match industrial needs. The general scheme of the apparatus is presented in Fig. 1. The ability to achieve synthesis on large surfaces is provided by the use of a series of four aerodynamic lenses implemented on the prototype set up between the source of nanoparticles and the deposition chamber. The lenses are composed of successive chambers separated by diaphragms usually used to produce collimated beam of nanoparticles [2]. Numerical and experimental studies show that is possible to obtain a divergent and homogenous jet of nanoparticles by adapting the geometry of the lenses. The ability to elaborate large and homogenous nanostructured films were investigated with different types of nanoaerosols of different sizes and densities. Films can be characterized in situ by FUV fast acquisition Spectroscopic Ellipsometrer from HORIBA. Samples composed of gold nanoparticles in a silica matrix will be shown. Many applications are already considered for this type of coatings, including photocatalysis, photovoltaic solar cells, aesthetic coatings for luxury industry, hard covering for tools or self-healing films. This work is currently supported by the French National Research Agency (ANR) under contract No ANR-14-CE07-0036.
Fig. 1: General scheme of the co-deposition prototype for large-surfaces.

References: