Association of PECVD process and chemical synthesis for the development of TiO2/SiO2 nanocomposite material: a new approach

Maria Mitronika¹, Jacopo Profili², Antoine Goullet³, Luc Stafford², Agnès Granier⁴, Mireille Richard-Plouet³

¹Jean Rouxel Insitute of Materials Nantes, Nantes, France ²Université de Montréal, Montréal, Canada ³Institut des Matériaux Jean Rouxel (IMN), Nantes, France ⁴Institut des Matériaux Jean Rouxel (IMN), Nantes, Canada

maria.mitronika@cnrs-imn.fr

During the past few decades, the Microelectromechanical systems (MEMS) have emerged in our daily life, giving us access to a wider variety of applications. Hence, the synthesis of new nanocomposite materials, that allows us to improve those systems, is of great importance. In view of enhancing the properties of these materials, the present work is devoted to the synthesis of titania/silica nanocomposite thin films through an original approach. The most significant challenge in the development of such nanocomposites is to control their morphology, their growth mechanisms, the incorporation of the nanoparticles in the composite and the distribution of them. In the past, numerous elaborations have been established, aiming at tuning and improving the synthesis of such materials, such as sol-gel, (plasma enhanced) chemical vapor deposition (PE-CVD), or physical vapor deposition (PVD). In this work, the coupling of the chemical synthesis and the plasma process for the development of TiO$_2$/SiO$_2$ nanocomposite films is reported. Initially, a colloidal solution consisting of TiO$_2$ nanoparticles is spin coated on thermally oxidized SiO$_2$ silicon wafers. Subsequently, the spin-coated samples are exposed to atmospheric or low-pressure plasmas in the presence of hexamethyldisiloxane (HMDSO) for the deposition of a silica matrix. Scanning electron microscopy (SEM) of these treated samples shows a good control over the distribution of the TiO$_2$ nanoparticles dispersed in the SiO$_2$ matrix. The morphology of the thin films is investigated through atomic force microscopy (AFM) and the chemical analysis of their surface by X-ray photoelectron spectroscopy (XPS). Preliminary results obtained by ellipsometry are used to describe the distribution of the nanoparticles in the matrix. Finally, the nanocomposite films obtained using a low pressure and an atmospheric pressure PECVD reactor have been compared.

Keywords
PECVD
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