STUDIES OF THE STRUCTURAL EVOLUTION AND FILM PROPERTIES OF PULSED MAGNETRON SPUTTERED TITANIA COATINGS

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ABSTRACT

It is well known that, depending on deposition conditions, the structure of titania coatings may be amorphous, anatase or rutile, or a mixture of phases. Many of the important functional properties of titania coatings, such as refractive index, photocatalytic activity, hardness, etc. are in turn, dependent on this structure.

In this study, coatings have been deposited onto glass substrates by reactive sputtering from metallic targets and directly from oxide powder targets. The magnetrons were driven in mid-frequency (100 – 350 kHz) pulsed DC mode and in HIPIMS mode (frequency range 50 – 1000 Hz). The as-deposited coatings were analysed by scanning electron microscopy (SEM), X-ray diffraction (XRD) and micro-Raman spectroscopy. Selected coatings were also annealed at temperatures in the range 100 – 800 ^{o}C and re-analysed. The photocatalytic activity of the coatings was assessed through measurement of the degradation of organic dies, such as methyl orange, under the influence of UV light. The rate of diffusion of sodium atoms from the substrates through the annealed samples was also investigated by secondary ion mass spectroscopy (SIMS).

It was observed that the 'low temperature' amorphous or nanocrystalline structure of the coatings evolved into a strongly anatase structure at annealing temperatures in the range 400 – 600 ^{o}C, depending on the specific deposition conditions used, and that this structural transformation strongly influenced film properties. For the HIPIMS coatings, some evidence of nanocrystallinity was observed in as-deposited coatings, which was not observed for the pulsed DC coatings.