INFLUENCE OF AUXILIARY PLASMA SOURCE AND ION BOMBARDMENT ON STOICHIOMETRY OF TiO2 THIN FILMS

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Formation of a hard ceramic surface layer by metal plasma immersion ion implantation and deposition (MePIIID) is a complicated process as quite a number of different species are interacting in the vacuum chamber and impinging on the surface. Metal ions, multiply charged and supersonic, generated by a cathodic arc are transported towards the substrate. Additionally, neutral gas is added and can interact with the metallic ions, leading to a partially ionized gas. During the high voltage pulses, ions are accelerated towards the substrate and are implanted. Due to the low ion energy in the range of 1 - 10 keV, a significant fraction of the surface will be sputtered during the pulses, leading to a reduced deposition rate. In a competing process between the pulses, metal ions are condensating on the surface, while additional neutral gas atoms can be chemisorbed by a reactive surface. The resulting growth rate and composition will be determined by the complex interplay of surface adsorption, ion implantation and preferential sputtering.

As an example, the detailed interactions in the system Ti-O are investigated. At sufficiently high oxygen partial pressures, a saturation of the O:Ti ratio near 1.95 is observed. With additional oxygen plasma generation, a further increase of the O:Ti ratio is possible. However, when using supplementary high energy ion bombardment, a strong preferential loss of oxygen is observed, but only until the initial equilibrium value is reached, at rather moderate total sputter yields. Thus, an independent control of O:Ti ratio and film morphology, mediated by the ion flux, is rather difficult to achieve.

Keywords

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TiO2