OR2407

Tuning the ion energy by bipolar HiPIMS to control of the Mg thin film microstructure

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High power impulse magnetron sputtering is a method renowned for the high ionization degree of the sputtered metal atoms. Traditionally, a high negative voltage pulse is applied and is followed by a long off time. Eventually, the energy of the bombarding metal ions is controlled during unipolar HiPIMS by applying a negative bias voltage on the substrate.
In this work, we use a power supply capable of applying a positive pulse after the negative one to control the ion energy, or stated differently bipolar HiPIMS as a tool to control the ion energy is studied. Both the influence of the delay time between the negative and positive pulses as well as the applied positive voltage is investigated by means of energy- and time-resolved mass spectrometry located at the substrate position. It is found that applying the positive voltage allows to significantly increase the energy of the bombarding ions. The observed changes as compared to a classic HiPIMS pulse can be successfully described. The technique is used to deposit Mg thin films. Film microstructure and texture were measured by X-Ray diffraction (XRD) and scanning electron microscopy (SEM). The film texture changes from random to a (002) fiber texture with increasing the positive pulse amplitude while a clear change of the surface morphology is observed. To benchmark these results, a comparison is made with conventional DC magnetron sputtering and unipolar HiPIMS.

Keywords
HiPIMS
Mg
thin films
microstructure
mass spectrometry