OR0401

Studies of hysteresis effect in reactive HiPIMS deposition of oxides

Tomas Kubart[1], Montri Aiempanakit[2], Joakim Andersson[1], Tomas Nyberg[1], Soren Berg[1], Ulf Helmersson[3]

[1]Ångström Laboratory / Uppsala University, Uppsala, Sweden [2]IFM-Materials Physics, Linköping University, Linkoping, Sweden [3]IFM-Materials Physics, Linköping University, Linkoping, Germany

tomas.kubart@angstrom.uu.se

High power impulse magnetron sputtering (HiPIMS) has shown to be capable of substantial improvement of the quality of sputter deposited coatings. Thanks to high degree of ionization, the energy input into the growing film may be significantly increased, leading to, for instance, improved adhesion, better crystallinity, or increased density of the coating. One of the issues of HiPIMS deposition is related to the deposition rate, which is typically lower than in a corresponding direct current (DC) sputtering process. This is of special importance in the case of deposition of oxides due to the low sputtering rate of most oxides. There have been a number of reports indicating that the hysteresis effect may be reduced in HiPIMS mode resulting in an increase of the deposition rate of stoichiometric compound as compared to a DC process in oxide mode.
In this study, we have analysed hysteresis behaviour of different metal targets sputtered in Ar/O_2 mixtures. Experiments were carried at various frequencies of HiPIMS and compared with DC sputtering. It is shown that for fixed pulse on time and a constant average power, there is an optimum frequency which minimizes the hysteresis effect. Computer modelling has been employed in order to optimize the process conditions. The effect of gas dynamics was analyzed as well as the influence of dynamical changes of the target surface. Our results indicate the observed hysteresis behaviour is related to the gas rarefaction. Based on studies, more advanced waveforms structures may be used to combine high degree of ionization and in the same time minimize the hysteresis effect.

Keywords
Magnetron sputtering
Hysteresis effect
HiPIMS
Oxides