Abstract Submitted
for the GEC16 Meeting of
The American Physical Society

An ionization region model of the reactive Ar/O_2 high power impulse magnetron sputtering discharge JON TOMAS GUDMUNDSSON, University of Iceland, Reykjavik, Iceland, DANIEL LUNDIN, LPGP, Universite Paris-Sud, Orsay, France, NILS BRENNING, MICHEL A. RAADU, CHUNQING HUO, KTH-Royal Institute of Technology, SE-100 44, Stockholm, Sweden, TIBERIU MINEA, LPGP, Universite Paris-Sud, Orsay, France — A reactive ionization region model (R-IRM) is developed to describe the reactive Ar/O_2 high power impulse magnetron sputtering (HiPIMS) discharge with titanium target. We compare the discharge properties when the discharge is operated in the two well established operating modes, the metal mode and the poisoned mode. Experimentally, it is found that in the metal mode the discharge current waveform displays a typical non-reactive evolution, while in the poisoned mode the discharge current waveform becomes distinctly triangular and the current increases significantly. Using the R-IRM we find that when the discharge is operated in the metal mode Ar^+ and Ti^+-ions contribute most significantly (roughly equal amounts) to the discharge current while in the poisoned mode the Ar^+-ions contribute most significantly to the discharge current while the contribution of O^+-ions and secondary electron emission is much smaller. Furthermore, we find that recycling of ionized atoms coming from the target are required for the current generation in both modes of operation. In the metal mode self-sputter recycling dominates and in the poisoned mode working gas recycling dominates, and it is concluded that the dominating type of recycling determines the discharge current waveform.

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Date submitted: 03 Jun 2016 Electronic form version 1.4