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Reactive high power impulse magnetron sputtering: combining simulation and experiment TOMAS KOZAK, JAROSLAV VLCEK, Department of Physics and NTIS - European Centre of Excellence, University of West Bohemia, Univerzitni 8, 306 14 Plzen, Czech Republic — Reactive high-power impulse magnetron sputtering (HiPIMS) has recently been used for preparation of various oxide films with high application potential, such as TiO_2, ZrO_2, Ta_2O_5, HfO_2, VO_2. Using our patented method of pulsed reactive gas flow control with an optimized reactive gas inlet, we achieved significantly higher deposition rates compared to typical continuous dc magnetron depositions. We have developed a time-dependent model of the reactive HiPIMS. The model includes a depth-resolved description of the sputtered target (featuring sputtering, implantation and knock-on implantation processes) and a parametric description of the discharge plasma (dissociation of reactive gas, ionization and return of sputtered atoms and gas rarefaction). The model uses a combination of experimental and simulation data as input. We have calculated the composition of the target and substrate for several deposition conditions. The simulations predict a reduced compound coverage of the target in HiPIMS compared to the continuous dc sputtering regime which explains the increased deposition rate. The simulations show that an increased dissociation of oxygen in a HiPIMS discharge is beneficial to achieve stoichiometric films on the substrate at high deposition rates.

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