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High rate reactive magnetron sputtering of oxides using sputtering yield amplification

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In this contribution, we summarize our work on increasing the deposition rate in reactive magnetron sputtering by sputtering yield amplification. Modelling of the sputtering process predicts that a very high deposition rate increase by more than 100% may be achieved for oxides. Comparable values were measured experimentally using a setup suitable for up-scaling. In sputtering yield amplification the target is doped with a heavy dopant in order to reflect the recoils created in a collision cascade towards the surface and thus increase the number of atoms sputtered from the surface. In order to realize the process, an experimental system for serial co-sputtering has been built and used for experimental studies. The dopants are introduced from an auxiliary cathode onto the primary rotating target and incorporated into the target surface by recoil implantation during sputtering. A necessary requirement for suitable doping elements is high atomic mass. Another important parameter is the surface binding energy as demonstrated by comparison of W and Bi, two heavy elements with very different surface binding energies. Using a dynamical model of the sputtering process, the performance of various doping elements is evaluated.
Reactive sputtering of Al and Ti targets with W and Bi doping was performed. The deposition rate of Al_2O_3 can be increased by 80 % by W doping of the Al target in very good agreement with predictions. For TiO_2, however, an increase by more than 100 % was observed, substantially higher than predicted. Finally, the optical properties of W doped Al_2O_3 and TiO_2 thin films are briefly discussed.

Keywords
Reactive sputtering
Oxides
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