Reactive magnetron sputtering –process control and hysteresis-free? reactive HiPIMS

Reactive magnetron sputtering is widely used for synthesis of various compound thin films. Especially in industry, high productivity is essential and there is a need for processes with high deposition rates. Achieving high deposition rate and true compound stoichiometry of the deposited film is, however, challenging in reactive sputtering. The relation between deposition rate or composition of the coating and flow of reactive gas is very non-linear and usually exhibits hysteresis behaviour.

After reviewing the hysteresis behaviour and basic strategies for process control in reactive magnetron sputtering, I focus on the recent research on reactive High Power Impulse Magnetron Sputtering (HiPIMS). Reactive HiPIMS is a promising technique which, while having the advantages of standard magnetron sputtering, utilizes ion assistance for growth of compound thin films with greatly enhanced properties. Reactive HiPIMS also presents an intriguing research topic challenging our understanding of the underlying physical processes.

Hysteresis of reactive HiPIMS is interesting and I discuss the various, and often contradicting, experimental results and the mechanisms responsible for the behaviour. Further, I show that the dynamics of reactive HiPIMS is dominated by surface processes with characteristic times much longer than the typical HiPIMS pulse on-times. The compound formation rate is significantly inhibited in HiPIMS as compared to the dc mode of operation, which also contributes to the reduced hysteresis.

SHORT BIO

Tomas Kubart graduated in Mechanical Engineering at the Czech Technical University in Prague. In 2005, he received PhD from the same university. At present, he leads the Thin Films group at the Department of Solid State Electronics at Uppsala University. The group has a long tradition of research on plasma technologies, especially magnetron sputtering. At present, Tomas is focusing on highly ionized deposition techniques and novel techniques for high quality thin films, especially oxides for electronics and energy applications.