PO3002

Influence of the discharge power on reactive and non-reactive magnetron sputtering of Ti in DC and pulsed DC mode

Christian Saringer[1], Robert Franz[1], Katrin Zorn[2], Christian Mitterer[1]

[1]Montanuniversität Leoben, Leoben, Austria [2]MIBA High Tech Coatings, Vorchdorf, Austria

christian.saringer@unileoben.ac.at

Magnetron sputtering is a highly flexible deposition technique that is nowadays used for the synthesis of a large number of different functional coatings in a diverse field of applications. Its versatility is based on the huge spectrum of coating materials achievable and on the vast amount of variable process parameters, like the possibility to use DC and pulsed discharges or the deposition in either, reactive and non-reactive mode. Its efficiency, however, is limited due to comparatively low deposition rates caused by the large amount of energy that is dissipated into heat. Therefore, it is of vital interest to increase the deposition rate in order to expand the applicability of this technique. A possible approach to overcome this limitation is to increase the discharge power to increase the sputter rate and, hence, the deposition rate. However, a few open questions remain like what is the influence of the discharge power on the process stability, the substrate temperature and the coating properties. The objective of this study is therefore to investigate the influence of the discharge power on aspects of both, the magnetron sputter process and the coatings deposited. In the current experiments, a titanium target was sputtered non-reactively in argon as well as reactively in a mixture of argon and nitrogen using both, DC and pulsed DC discharges. The average power density was systematically varied between 4 and 34 W/cm². The substrate temperature was monitored during the non-reactive deposition runs, revealing more intense substrate heating during pulsed DC sputtering compared to DC sputtering. For the reactive sputter process, hysteresis experiments were performed in DC and pulsed DC mode to determine the process stability in terms of nitrogen gas flow and discharge voltage. Reactively sputtered coatings were then deposited at a substrate temperature of 200°C in metallic and poisoned (or compound) mode at constant discharge powers. The resulting microstructure and mechanical properties of the TiN_x coatings were characterized by X-ray diffraction, scanning electron microscopy and nanoindentation.

Keywords
Reactive sputtering
Power density
Titanium nitride