Impact of sputtering power on trace impurities in binary oxides: A ToF-ERDA characterization study

Filip Ferenčík, Jozef Dobrovodský, Zoltán Száraz, and Pavol Noga

Slovak University of Technology in Bratislava, Faculty of Materials Science and Technology in Trnava, Advanced Technologies Research Institute, Ulica Jána Bottu č. 2781/25, 917 24 Trnava, Slovakia

Performance of Binary oxides, used especially in the semiconductor industry, are significantly affected by impurity concentrations. Power density is one of the sputtering parameters that significantly affects these impurities. Increasing the power density reduces the amount of contaminants in the thin film metals. This study examines how power density in magnetron sputtering impacts hydrogen, carbon, and other impurities in silicon, titanium, copper, silver, and palladium binary oxides, which are common in the semiconductor industry and needed further investigation for comparison with metals.

We focused on a narrow power density range of 200-300W using DC reactive magnetron sputtering on a 3-inch target. Six samples of each material were prepared under fixed conditions of $5\times$10E-3 mbar pressure in an Argon and Oxygen atmosphere with a flow rate of 40/10 sccm. Data analysis was performed on films of the same thickness, ignoring the surfaces of both the substrate and the film.

Using Time-of-Flight Elastic Recoil Detection Analysis (ToF-ERDA), we detected very low but important changes in impurity concentrations and understood how they relate to the sputtering power density. The results offer new insights into optimizing deposition parameters to improve film purity and performance.

The Slovak Research and Development Agency, grant No. APVV-20-0220.