# Crystallographic Orientation-Dependent Growth of Nanoparticles via Magnetron Sputtering on monocrystalline Rutile $TiO_2$

Filip Ferenčík[1], Viliam Vretenár[2], Diana Fabušová[1], and Pavol Noga[1]

[1]*Slovak University of Technology in Bratislava, Faculty of Materials Science and Technology in Trnava, ATRI, Ulica Jána Bottu č. 2781/25, 917 24 Trnava, Slovakia*
[2]*Centre for Nanodiagnostics of Materials, Faculty of Materials Science and Technology, Slovak University of Technology in Bratislava, Vazovova 5, Bratislava, 81243, Slovakia*

This work presents a novel approach to the preparation of nanoparticles using magnetron sputtering on monocrystalline rutile $TiO_2$ substrates with defined crystallographic orientation. We found that the crystallographic orientation of the substrate significantly influences the nucleation and growth processes of nanoparticles, resulting in particle sizes and ranging from a few to several tens of nanometers. The mechanisms of there processes and their effects on the characteristics of the nanoparticles are investigated using scanning and transmission electron microscopy combined with Auger Electron Spectroscopy and Time of Flight Elastic Recoil Detection Analysis. Our results provide new insights into the controlled synthesis of nanomaterials and open avenues for optimizing nanoparticle properties for specific applications. In particular, we focused on the formation of PdCu nanoparticles, which are wdely used in catalysis, especially in C-C coupling reactions. Our method offers a new route for their preparation and enables the study of the substrate-induced effects on nanoparticle characteristics.

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