

Enhanced electrochemical dissolution of Ag nanoparticles in the presence of Pt nanoparticles

Oleg Prymak¹, Kateryna Loza¹, Oliver Wetzel¹, Marc Heggen², Marina Breisch³, Manfred Köller³, Christina Sengstock³, Matthias Eppe¹

¹Institute of Inorganic Chemistry and Center for Nanointegration Duisburg-Essen (CeNIDE), University of Duisburg-Essen, oleg.prymak@uni-due.de, Germany

²Ernst Ruska-Centre and Peter Grünberg Institute, Forschungszentrum Jülich GmbH, Germany

³BG University Hospital Bergmannsheil Bochum / Surgical Research, Ruhr University Bochum, Germany

Metallic nanoparticles (NPs) represent a well-established part of nanoscience today. Noble metals like silver (Ag) and platinum (Pt) are of particular interest due to their unique antibacterial and catalytic properties, respectively. The antimicrobial activity of Ag NPs is related to the oxidative release of Ag ions, which increases with a decreasing particle size and presence of the oxidizing species, e.g. molecular oxygen [1]. The dissolution of Ag NPs can be further facilitated by the combination of Ag with the electrochemically more noble Pt by their physical mixture in solution, thereby creating a sacrificial anode system for Ag [2]. Here, spherical PVP-coated Ag (10 nm) and Pt (3 nm) NPs were wet-chemically synthesized and mixed as aqueous dispersion with different mass ratios of Ag:Pt (e.g. 1:1, 1:2, 1:3, 1:6). It was shown that the dissolution of Ag NPs was strongly enhanced by the presence of Pt NPs in chloride-containing aqueous dispersion (3M KCl). This behavior was confirmed (Fig. 1) by X-ray powder diffraction (PXRD) and applying Rietveld refinement and transmission electron microscopy (TEM). At the same time, only a slow dissolution of Ag NPs in presence of Pt NPs was detected in water or ammonium acetate (3M NH₄Ac) or phosphate-buffered saline (PBS) solutions.

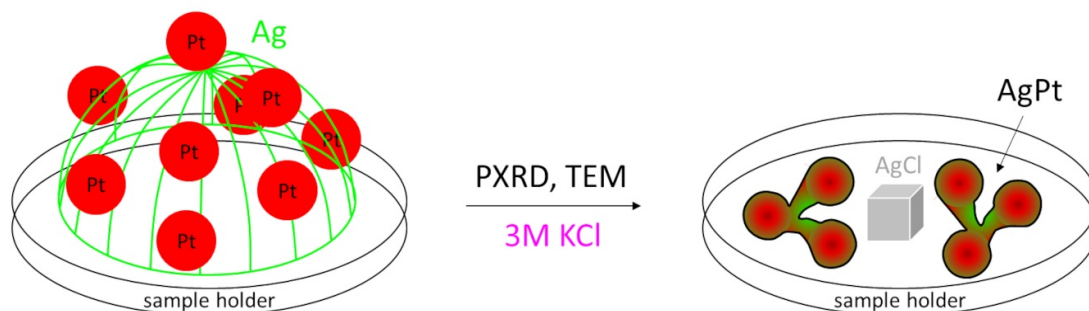


Figure 1: Schematic representation of the analyzed mixture of larger Ag (green) and smaller Pt (red) NPs dropped on a sample holder (left) and treated with a 3M KCl solution (right).

References:

- [1] K. Loza *et al.*, *J. Mater. Chem. B* 2 (2014) 1634
- [2] M. Breisch *et al.*, *Nanotechnology* 31 (2020) 05570