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Silver Nanoplates: Morphology Exhibiting Strong Plasmonic and Catalytic Properties

R. Mravljak[a], A. Podgornik[a,b*]

[a] *Department of Chemical Engineering and Technical Safety, Faculty of Chemistry and Chemical Technology, University of Ljubljana, Ljubljana SI-1000, Slovenia*

[b] *COBIK, Mirce 21, 5270 Ajdovščina, Slovenia*

**Ales.Podgornik@fkkt.uni-lj.si*

Silver nanoplates, either in trigonal or hexagonal morphology, are crystals formed due to the stacking faults in a crystal lattice, resulting in highly asymmetric crystals of otherwise cubic silver morphology. Because of that they exhibit pronounced plasmonic properties also in visible spectra. As such they are attractive material for various applications like enhance sensors or as catalysts.

In this work we present novel method to prepare sliver nanoplates in gram quantities. The method is seedless, consists of few reagents, enables preparation of silver nanoplates with desired optical properties in high concentration, is scalable and allows their long-term storage. The developed method is based on silver nitrate, sodium borohydride, polyvinylpyrrolidone and H2O2 as the main reagents, while antifoam A204 is implemented to achieve better product quality on larger scale. Prepared nanoplates was dried and spontaneously dispersed after at least one month of storage in the dark without any change in plasmonic properties.

Their application for catalysis is demonstrated by preparing the catalytic reactor silver nanoplates by depositing them on positively charged high internal phase emulsion monoliths via their negative zeta potential. Such reactor was used in a flow-through mode for catalytic reduction of 4-nitrophenol and demonstrated to be stable under various elution conditions, even after prolonged usage.

Furthermore, their plasmonic effect in visible spectra was exploited for potential use in modern art by drying silver nanoplates on different surfaces, resulting in a variety of colors but, more importantly, patterns of varying complexity, from simple multi-coffee-rings structures to dendritic forms and complex multi-level Sierpiński triangle fractals.

Keywords: silver nanoplates, plasmon, catalysis, tubular reactor