

## The role of solvent in methylviologen mediated electrosynthesis of silver nanoparticles stabilized with polyvinylpyrrolidone

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### Abstract

Methylviologen is effective mediator of electrochemical reduction of  $\text{Ag}^+$  ions to  $\text{Ag}^0$  in solution bulk in DMF/0.1 M  $\text{KPF}_6$ , DMF (40 vol.%) –  $\text{H}_2\text{O}$ /0.1 M  $\text{KNO}_3$ ,  $\text{H}_2\text{O}$ /0.1 M  $\text{KNO}_3$  media at potential of the  $\text{MV}^{2+}/\text{MV}^{+}$  redox couple at room temperature. When  $\text{Ag}^+$  is directly reduced on the glassy carbon electrode, the generated metallic silver is almost completely deposited on the electrode in all media both in the absence and in the presence of Ag nanoparticles stabilizer, polyvinylpyrrolidone (PVP). In the mediated process, metal is not deposited on the cathode and the entire  $\text{Ag}^+$  generated in situ upon dissolution of the silver anode during diaphragmless electrolysis is transformed quantitatively into polydisperse Ag nanoparticles in the solution bulk. The nature of the solvent does not affect on the efficiency of the mediated process, the form of nanoparticles, but influences only on the average particle size, and as a result, the wavelength ( $\lambda_{\text{max}}$ ) of their absorption band. Spherical Ag nanoparticles encapsulated in the PVP shell are formed in all media. Ag nanoparticles of  $20 \pm 17$  nm ( $39 \pm 26$  nm together with shell,  $\lambda_{\text{max}} = 408$  nm),  $39 \pm 16$  nm ( $51 \pm 16$ ,  $\lambda_{\text{max}} = 416$  nm),  $34 \pm 17$  nm ( $45 \pm 25$  nm,  $\lambda_{\text{max}} = 406$  nm) average sizes were obtained in DMF, aqueous DMF and water respectively. All resulting Ag nanoparticles were characterized by dynamic light scattering, UV-visible spectroscopy, scanning and transmission electron microscopy.