Deposition of silver nanoparticles on to thin films of ionic liquid on SiO_2

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1. Motivation

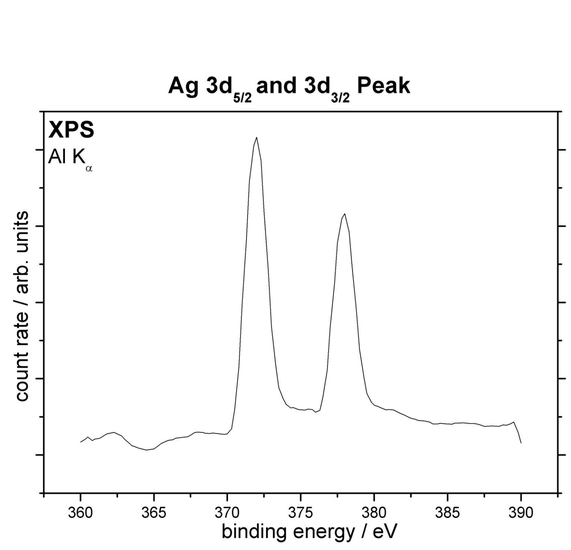
Room-temperature ionic liquids (RT-ILs) have recently attracted much attention as a new organic solvents and functionalized materials. As ionic liquids have very low vapour pressures, at room temperature they can be employed in vacuum experiments as fluid substrates or solvents. At elevated temperatures it is possible to evaporate them in UHV and deposit thin ionic liquid films. These thin films could be used now as buffer layers for nanoparticle growth. In this work the influences of monolayers of 1-ethyl-3-methylimidazolium bis(trifluoromethylsulfonyl)imide [EMIm]Tf_2N on the growth of silver nanoparticles on SiO_2 were investigated. The chemical composition and electronic structure of the silver-IL-SiO_2 interface was characterized by Metastable Impact Electron Spectroscopy (MIES) and UPS (He I). The particles size distribution was determined with Atomic Force Microscopy (AFM). We compare these results with measurements on silver deposited on pure SiO_2.

2. Experimental

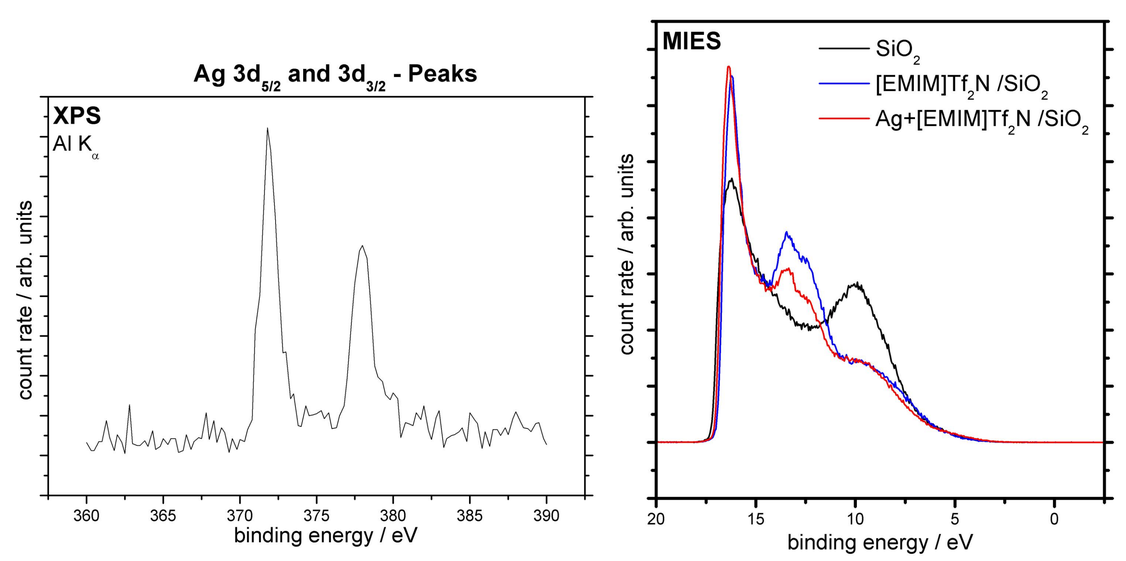
XPS: X-ray source (AlK_α)
UPS: He I (21.2 eV)
MIES: He* 2^3S_1 (19.8 eV)
UHV systems with base pressure < 2.0×10^{-10} Torr
Substrate: **SiO_2/Si(100)**
[1-**E**thyl-3-**M**ethyl-**Im**idazolium**]Tf_2N** films are ~0.5-1 nm
Ag covering between 0.1 and 1 nm

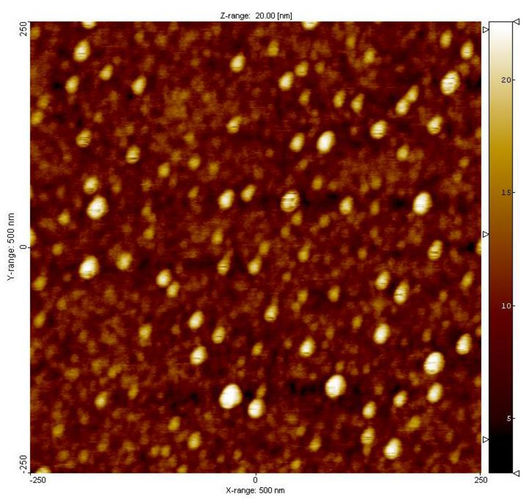
RT-IL's film preparation:
The RT-IL films were prepared by evaporating of ultrapure Ionic Liquids in UHV system at 140°C for 120 sec onto the SiO_2 substrate.
Ag particles deposition:
After evaporating RT-IL onto SiO_2 Ag was evaporated on the thin film by using metal evaporator. The evaporation occurs in UHV chamber with the base pressure <$2*10^{-8}$ Torr.

3. Ag on SiO_2

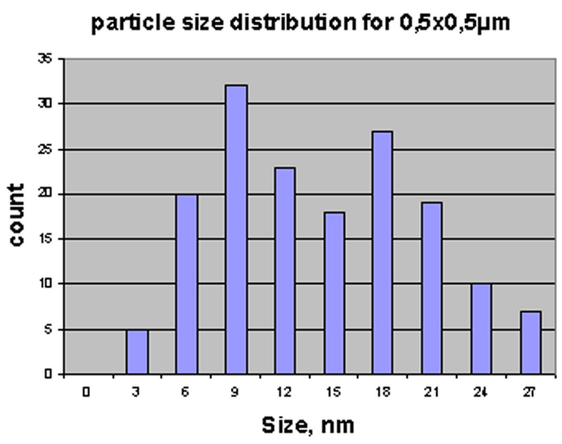


4. Ag+[EMIm]Tf_2N on SiO_2

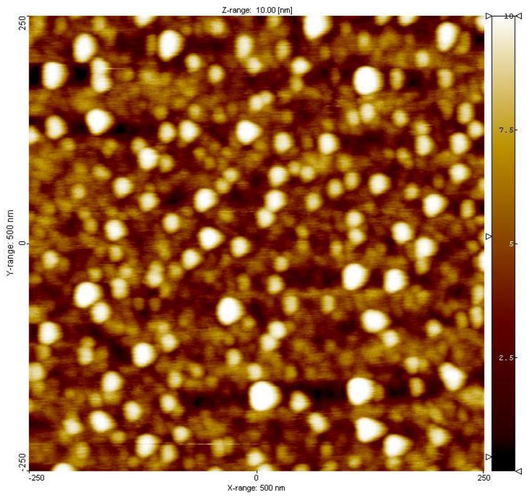




resolution: 500x500nm



	Ag / SiO_2	**$Ag + [EMIm]Tf_2N / SiO_2$**
MIES Results		
IL evaporation:		- O 2p decreases typical peaks of [EMIm]Tf_2N at 11 eV and 12 eV
Ag evaporation:	- O 2p decreases typical Auger process change from AD to AN	- peaks of IL at 11 eV and 12 eV decrease
UPS Results		
IL evaporation:		- O 2p decreases typical peaks of [EMIM]Tf_2N at 11eV and 12eV
Ag evaporation:	- O 2p decreases	- additional O 2p decreases - peaks of IL at 11eV and 12eV decrease
XPS Results		**Film thickness**
IL evaporation:		- Si 2p decreases 0.3 nm
Ag evaporation:	-Si 2p decreases add-on of Ag 3d	- additional Si 2p decreases add-on of Ag 3d for Ag 0.2 nm
AFM Results:		
	- round particles - homogeneously distribution	- round particles - homogeneously distribution
Particle Size Distribution		
average size	-13.1 nm	- 18.6 nm
particle number	- 159	- 164



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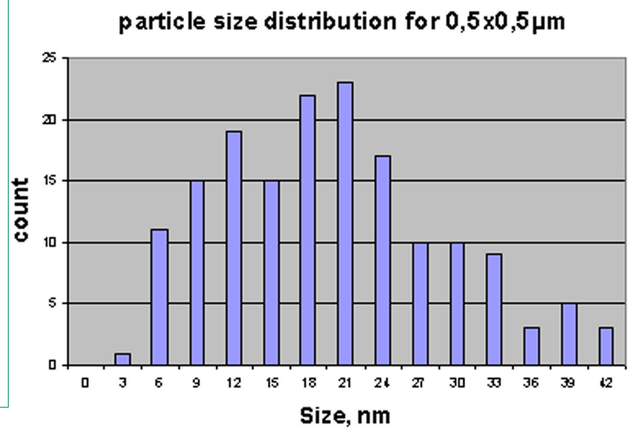

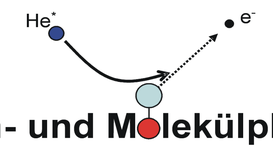

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