Nanocomposite films composed of Ag nanoparticles (NP) within a TiOx matrix present photochromic properties [1]. The permanent or reversible changes of color occurring under illumination by UV/visible lasers rely on the control of the localized surface plasmon resonance (SPR) of Ag NP. They result from the tuning of the NP size/shape distribution through photo-activated redox reactions occurring specifically with the TiOx matrix.

The morphology of Ag:TiOx nanocomposite is investigated by high-angle annular dark-field HAADF-STEM, structural informations are obtained by energy filtered electron diffraction (EFED) coupled with electron energy loss spectroscopy (EELS). Samples grown under different deposition conditions (TiOx thickness, O2 pressure in the chamber, ...) are investigated.

For TiOx grown under a metallic sputtering mode (low oxygen pressure), the STEM images reveal an homogeneous distribution of Ag nanoparticles with a rather large size distribution and various shapes. Their cristallinity is assessed by energy filtered electron diffraction. The porosity of the TiOx matrix is revealed by the HAADF images. Whereas the diffraction pattern of TiOx would suggest an amorphous structure the ELNES recorded on the O K and Ti L23 edges suggest the presence of a short range ordering of theTiO6 octaedra. The change of growing mode (under higher oxygen pressure) for TiOx, produces dramatic changes in the morphology of the nanocomposite: the Ag particles, if still present, have not been clearly resolved.

The influence of the thickness of the TiOx capping layer is investigated as well. It reveals that a threshold thickness exists below which the samples become sensitive to the electron beam, which promote morphological changes of the nanoparticles.

The morphological and structural insights are further compared with in-situ reflectance measurements [2].

References

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