

Spectroscopic Studies of the Structure and Stability of Silver Nanoparticles in LBL Polyelectrolyte Films

Haybat Itani^{1*}, Patrick Keil¹, Monika Santa¹, Aleksander Kostka¹, Guido Grundmeier²

¹ Max-Planck Institut für Eisenforschung GmbH, Max-Planck Straße 1, D-40237, Düsseldorf - Germany

² Department of Technical and Macromolecular Chemistry, University of Paderborn, Warburger Straße 100, D-33098 Paderborn - Germany

* IMPRS-SurMat: International Max-Planck Research School for Surface and Interface Engineering in Advanced Materials

Abstract

The system under-study is consisting of embedded Ag-nanoparticles inside a layer-by-layer polyelectrolyte film composed of polyacrylic acid and polyallylamine hydrochloride. Incorporation of the nanoparticles is achieved by diffusion of Ag^+ inside the matrix at different pH-values and various numbers of adsorbed bi-layers [1], [2], [3]. The formation of metallic Ag nanoparticles is realized by reduction in dilute NaBH_4 aqueous solution [4]. The structure of Ag nanoparticles characterised by local distances and coordination shells around the absorbing atom was investigated by means of X-ray Absorption Spectroscopy (XAS). The analysis of the near edge structure reflects the fraction composition of the embedded Ag before, during and after the reduction process and highlights the nanoparticle formation at the carboxylate sites. The size and the crystallographic properties of the formed nanoparticles were investigated by means of HR-TEM while the optical properties were monitored in-situ by means of UV-Vis Spectroscopy. Kinetic exchange at the interface of the Ag-nanoparticles and the polymer matrix was examined by means of Surface Enhanced Raman Scattering (SERS).

Keywords: Ag nanoparticles, LbL, XAS, HR-TEM, in-situ UV-Vis spectroscopy, SERS.

[1] Radeva, T.; Grozeva, M. *Journal of Colloid and Interface Science*, **2005**, 287, 415-421.

[2] Fujita, S.; Shiratori, S. *Thin Solid films* 499, **2006**, 54-60.

[3] Grunlan, J. C.; Choi, J. K.; Lin, A. *Biomacromolecules*, **2005**, 6, 1149-1153.

[4] Pal, T.; Sau, T. K.; Jana, N. R. *Langmuir*, **1997**, 13, 1481-1485.