Fabrication of Silver Nanospheres and Nanorods-Attached ITO Surfaces Using a Seed Mediated Growth Approach

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The shape and size of nano-particles are known to affect their unique magnetic, electronic and optical properties. Recently, much attention has been devoted to the fabrication of nanoparticles having various shapes and sizes. Among them, Murphy and the coworkers successfully synthesized the silver and gold nanorods and nanowires with a seed mediated growth approach in aqueous solution [1,2]. In their procedure, Au^{3+} or Ag^{+} was reduced in the presence of cetyltrimethylammoniun bromide (CTAB) by adding the seed particles of nanospheres to form the rod-liked structure.

By applying the seed mediated growth approach, our group has succeeded in fabricating Au nanoparticles attached indium tin oxide (ITO) surface [3]. The resistivity of the formed surface was confirmed to be smaller than the ITO surface on which Au nanoparticles attached using a bridging reagent.

As well as gold, silver is known as a good electrode material with high electrical conductivity. Furthermore, for Ag nanoparticles attaché on the conducting surface, we can expect some biocompatibility different from Au nanoparticles and the excitation of surface enhanced Raman scatting. So in the present work, the seed mediated growth approach was applied to the formation of Ag nanoparticles on ITO surface.

As the actual procedure to modify the ITO surface with Ag nanoparticles, the seed solution containing Ag seeds (3-5 nm) were prepared at first by reducing Ag^{+} with $NaBH_4$. Then the bare ITO was immersed into the seed solution to attach the Ag small nanospheres on the surface. The seed particles-attached ITO was next immersed in the growth solution containing CTAB, ascorbic acid and NaOH. The formation of Ag nanoparticles on the ITO surface was characterized using an FE-SEM.

Figure 1and 2 show that FE-SEM images of Ag nanoparticles attached ITO surfaces prepared by the seed mediated growth approach with different concentration of ascorbic acid (0.56 mM and 0.89 mM). Figure 1 clearly shows the Ag nanoparticles were formed on the ITO surface. The diameter of the sphere nanoparticles was 30-40 nm. The aspect ratio of nanorods formed sparsely was 15-25. This result indicates that Ag seeds attached on the ITO grew significantly in the growth solution with the presence of CTAB. Figure 2 shows the FE-SEM image obtained after treating with the higher concentration of ascorbic acid (0.89 mM). The formation of Ag nanorods and nanowires was observed together with the formation of large nanocrystals. As shown in the FE-SEM images, it was found that the formed structures of Ag nanoparticles were sensitive to the concentration of ascorbic acid in the growth solution.

In conclusion, it was found that the dispersed Ag nanoparticles were found to be attached on the ITO surface using the seed mediated growth approach. The electrochemical behaviors of the Ag nanoparticles-attached ITO electrodes also will be presented in the meeting.

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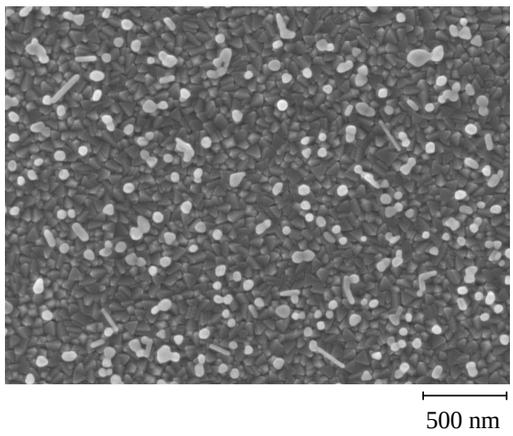

Figure 1. FE-SEM image of Ag nanoparticles-attached ITO surface prepared in the growth solution containing low concentration of ascorbic acid (0.56 mM).

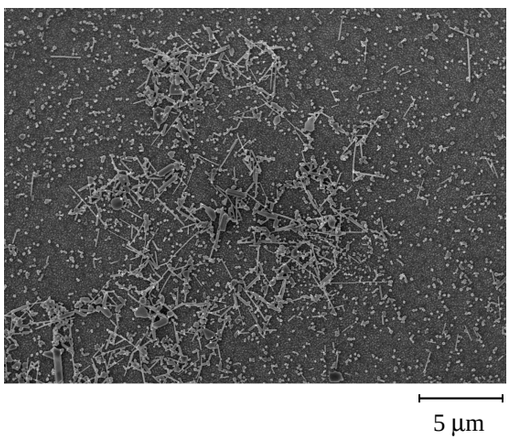

Figure 2. FE-SEM image of Ag nanoparticles and nanowires-attached ITO surface prepared in the growth solution containing low concentration of ascorbic acid (0.89 mM).