Novel Synthesis and In-Situ Characterization of Nano-Metal Electrode by Using f-NSOM Technique for Fuel Cell Application

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We have modified a commercial NSOM microscope to enable scanning and imaging in liquids, with a stability of several hours. This modification, denoted as f-NSOM, has been mainly used to obtain high resolution topography imaging. In the present work, we will demonstrate the application of our f-NSOM for synthesis of nano-sized structures.

Here, for fuel cell application, we investigated synthesis and in-situ characterization of nano-metal electrode by using our f-NSOM technique. By comparing piranha-treated non-conductive glass with untreated substrates, it was revealed that the adhesion of Ag deposits, formed by direct Ar laser exposure, to the surface is much enhanced in 0.5 mM $AgNO_3$ solution containing citrate ion.

The SEM micrographs revealed that the morphology of Ag varies from dots to 3-D networks of nanometer dimension with increasing laser intensities. From the topography before and after the exposure of laser through the f-NSOM tip, we succeeded in utilizing f-NSOM for in-situ characterization of the deposit just after its formation in liquid.

For a well defined light spot in obtaining actual nano-sized Ag deposits, we applied Al evaporated coating as an aperture layer to the f-NSOM optical fiber. With the Al coated tip, we obtained a highly reduced spot size and hence reduced the size of Ag deposit to the nanometer dimension. This is well validated both by ex-situ SEM in vacuum and by in-situ f-NSOM topography in solution.

In the near future, these results will be extended to advanced nano-lithography and in-situ characterization of those nano-sized structures.

References

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