Cross-Sectional Transmission Electron Microscopy Observation of Li-C Nanocomposites Deposited onto Au Protrusions

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In the TEM analyses, cross-sectional observation (X-TEM) is favorable in achieving high resolution images and better microstructural information of the material. However, X-TEM generally requires sample thickness less than 100nm, thus the time-consuming sample preparation such as the combination of mechanical polishing and ion-milling or focused ion-beam is unavoidable. To ease this, here we demonstrate the use of Au nanoprotrusions (AuNPs) fabricated by Ar^+ ion sputtering as a characterization platform, and lithium-carbon (Li-C) nanocomposite [1] was deposited thereon for X-TEM observation.

In this TEM observation, JEM ARM 200F operated at 200 kV equipped with electron energy loss spectroscopy (EELS) was employed. Prior to the X-TEM analyses, the fabrication of AuNPs was optimized. Depending on the sputtering parameters, the AuNPs altered in shape from slender needle-like, needle-like, pencil-like [Fig. 1(a)] and finally to a dull conical structure. The X-TEM observation on Li-C [Fig. 1(b)] revealed that the metallic Li embedded in amorphous C matrix [Fig. 2] was clearly observed in lattice image. The result was further confirmed by EELS analysis revealing the metallic Li peak.

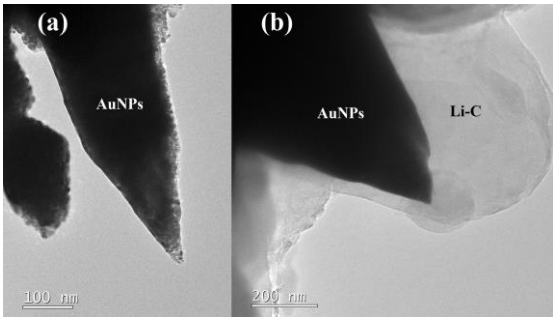

Fig. 1 Typical TEM images of (a) AuNPs and (b) Li-C deposited on AuNPs.

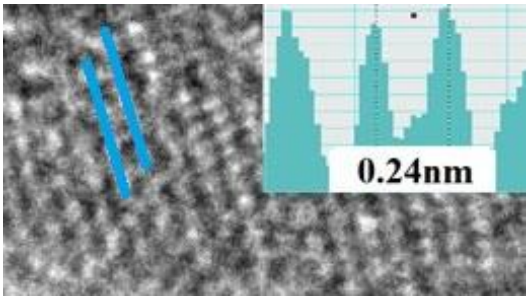

Fig. 2 Lattice image of metallic Li embedded in amorphous carbon matrix.

The controllable fabrication of AuNPs was successfully presented and the X-TEM observation of Li-C was performed without the unfavorable sample preparation. From X-TEM, metallic Li was preserved in Li-C film, which would be the promising candidate for anode of Li ion battery of next generation. Our next step is the X-TEM during/after charge-discharge process.

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[1] S. Subash, et. al, Nanomaterials 10 (2020) 1483.