Synthesis and Characterization of PEDOT/Au Nanocomposites

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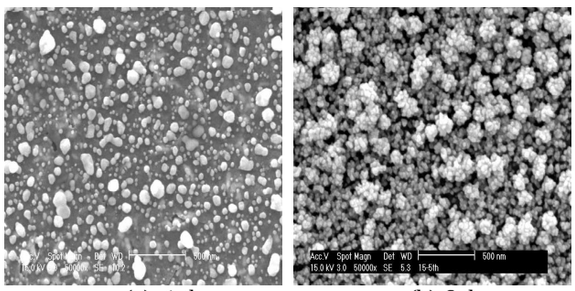
The conducting polymer is an exiting class of materials that combine the functionality of traditional organic polymers with the electrical conductivity of metal.[1] As a consequence of their unique electrochemical properties, conducting polymers are being intensely investigated for application in the electronic sector. However process in the integrating conducting polymer into current technology has been hampered by their relative instability. The reason for their instability lies in the fact that conjugated polymer must be "doped" (i.e. oxidized or reduced) in order to exhibit appreciable conductivity. Unfortunately, the polymers are mush less stable in their oxidized or reduced state.[2] Among the various class of conducting polymers, poly (3,4-ethylenethiophene) (PEDOT) is the most successful conducting polymer due to its excellent environmental stability, high conductivity and transparency in thin oxidized film.[3] However, PEDOT still has some shortcomings for practical application compared to metal.

In this work, PEDOT/Au nanocomposites were prepared using electroless deposition technique of $AuCl_3$ on the PEDOT film. Au^{3+} has sufficient power to oxidize the neutral PEODT film while it reduced to form Au^0 nanoparticles in the polymer matrix. The PEDOT films were fabricated with inorganic silicate network using 3-mercaptopropyltrimethosilane to provide superior mechanical properties as well as stabilizing Au nanoparticles. Au nanoparticles were deposited on PEDOT film by soaking in $AuCl_3$ solution. The size and the shape of nanoparticles are monitored by SEM and the surface conductivity is measured by 4-point probe method. The size of gold nanoparticles is about 20-100 nm depending on the number of redox cycles. As the number of redox-cycle is increased, the particle size and density is gradually increased as shown in Fig. 1. The conductivity also is enhanced up to 250 S/cm as shown in Fig. 2. The formation of gold nanoparticle is also confirmed by the X-ray photoelectron spectroscopy (XPS). The presence of characteristic peaks assigned to gold species is observed at the binding energy of 84.4 and 88.0 eV.[4] The crystallographic structure of gold was also monitored using X-ray diffraction technique in which the growth of particle size is clearly observed as shown in Fig. 4.[4]



(a) 1 th (b) 6 th

Figure 1. SEM Image of PEDOT/Au nanocomposite by increasing redox-cycle.

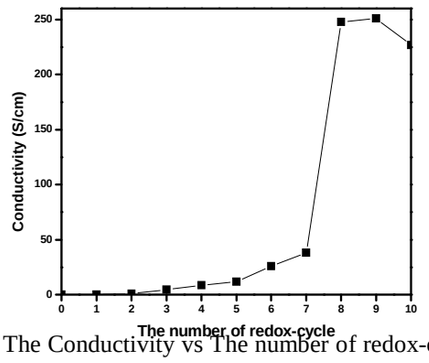


Figure 2. The Conductivity vs The number of redox-cycle.

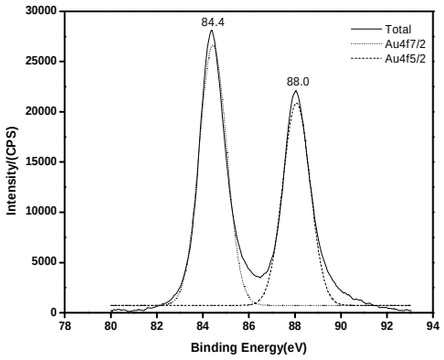


Figure 3. Au 4f XPS spectrum of PEDOT/Au film

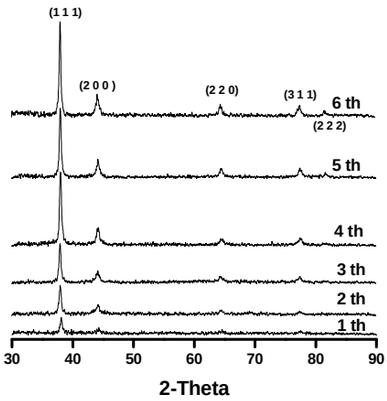


Figure 4. . XRD of PEDOT/Au nanocomposite by increasing redox-cycle.

Reference

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