FORMATION OF COPPER SULFIDE LAYERS ON POLYPROPYLENE BY CBD METHOD

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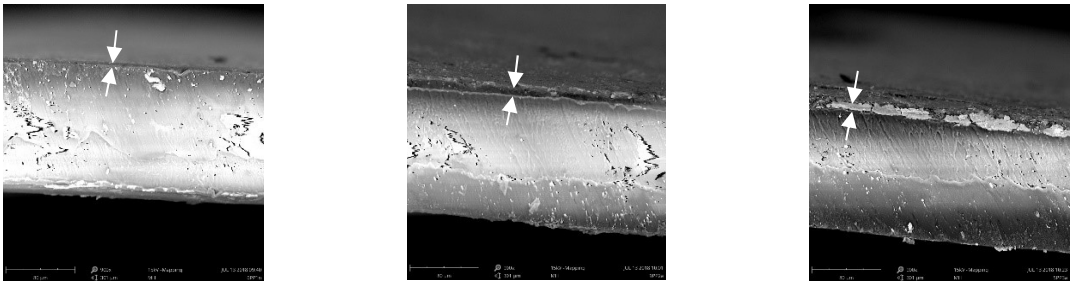
Nanocrystalline copper sulfide (Cu_xS), deposited as a thin film on the different substrates, is considered as a promising material for solar energy conversation system, due to their structural and electrical properties. One of the interesting semiconducting layers is copper sulfide due to its metal-like electrical conductivity, chemical-sensing capability, and ideal characteristics for solar energy absorption. Consequently, polymers modified with copper sulfide layers are used as the conductive substrates for deposition of metal and semiconductors; as gas sensors functioning at temperatures tending to room temperature; in thermoelectric applications; in solar cells; in lithium ion batteries.

We have chosen polypropylene (PP) film as a cheap, chemically stable, and flexible substrate. The hydrophobic PP requires an initial surface pre-treatment and weight losses after chemical treatment are recommended to be 2 g m^{-2}. This result was reached when PP film was etched for 25 min at 90 °C with oxidizing solution (H_2SO_4/H_3PO_4 (1:1), saturated with CrO_3).

The Cu_xS thin films deposit was carried out at room temperature by using the following procedure: 0.05 M $CuCl_2$ and 0.05 M $Na_2S_2O_3$ were mixed, the pH of the resultant solution was adjusted to 3. The pre-treated PP samples were immersed vertically along the wall of the reactor and were left undisturbed for deposition of Cu_xS films for 16 h at 20 ºC. At the end of the deposition time, the samples were taken out, and then rinsing of the substrate with distilled water for 30 s removed the desorbed ions and dried in a desiccator for 8 h. The deposition process was carried out by repeating such deposition cycles 3 times. Formed samples were annealed at 80 ºC for 30 min. Electrical resistivity was measured, and SEM/EDS investigation were performed after each formation cycle and after annealing of the samples.

The room temperature electrical resistivity of the formed layer after 1st deposition cycle was about 10 kΩ/□, after 2nd – 180 Ω/□, and after 3rd – 130 Ω/□. After annealing electrical resistivity decreased to 7 kΩ/□, 170 Ω/□ and 110 Ω/□ accordingly.



a b c

Fig. 1. Cross section of PP/Cu_xS composite after: a) 1st deposition cycle, b) 2nd deposition cycle; c) 3rd deposition cycle

Analysis of SEM images of PP/Cu_xS films showed that after 3 deposition cycles, the PP substrate was completely covered by Cu_xS particles. Cross sectional image (Fig. 1) demonstrated growing of Cu_xS layer with increasing of the cycle number.