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Structural and Morphological Evolution of ZnO Nanostructures Hybridized Seeded on Carbon Nanotubes Cotton

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P07

INTRODUCTION

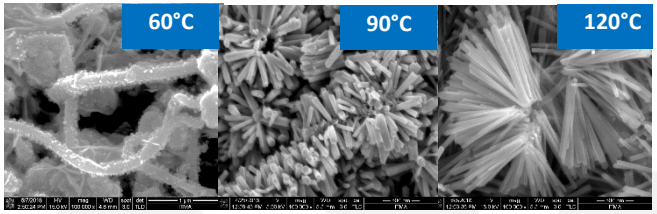
The impact of temperature of zinc oxide nanostructures on carbon nanotubes cotton network growth via chemical bath deposition method was investigated. Carbon nanotubes cotton (CNTC) was derived from waste cooking palm oil as the carbon source via floating catalyst (FCCVD) chemical vapor deposition. ZnO seed layer for growth patterning localization enfolded CNTC facet including the void in between the individual carbon nanotube threats as the layer gets thicker. ZnO nanorods were grown on CNTC using chemical bath deposition method for 3 hours. It was observed that the nanorods diameter and length increased proportionally to the increased of seed layer thickness.

MATERIALS & METHODS

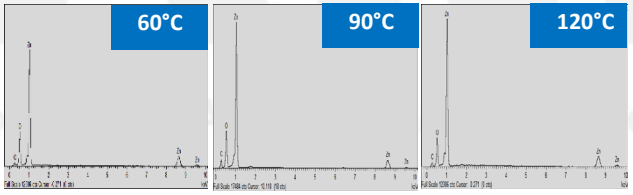
Carbon nanotubes cotton (CNTC) from waste cooking palm oil (WCPO) was synthesized using in-house chemical vapor deposition reactor. WCPO was refined and heated at 100 ℃ to eliminate any impurities present during cooking or frying process. A buffer layer for patterning were deposited on the surface of CNTC at a fixed current, duration and gas pressure applied to a 99.9% ZnO target. To grow the ZnO nanostructures, a solution was prepared by dissolving 0.05 M of zinc nitrate hexahydrate with a certain amount of hexamethlenetetramine (HMT) in 100 ml deionized water and stirred for 30 minutes. After that, sample was placed in a beaker filled with the precursor solution and left in the oven for 3 hours at 60° C, 90° C and 120° C temperature. The sample was rinsed with deionized water and dried. Characterizations were carried out to determine the properties of the sample.

RESULTS & DISCUSSION

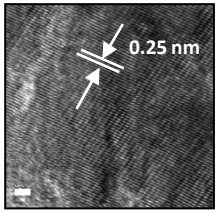
FESEM



The resulted buffer thickness layer was 81.6 nm after ZnO was deposited onto CNTC at sputter current of 150 mA for 4 minutes. It was observed that the nanorods diameter and length increased proportionally to the increased of synthesis temperature. The highest aspect ratio is 9.21 corresponds to the highest synthesis temperature of 120° C at seed layer thickness of 81.6 nm.



The energy dispersive x-ray (EDX) analysis confirmed the presence of carbon atoms in the sample representing CNT and ZnO. All heteroatoms in the waste cooking palm oil such as S, N and O were removed during the high temperature synthesis via FCCVD.



The high-resolution TEM image of the sample shows that the root of ZnO nanostructures are affixed on CNTs wall. The ZnO d^{101} spacing is 0.25nm in accordance to JCPDS number 36-1451.

CONCLUSION

ZnO nanorods were succesfully grown on the surface of CNTC prior to buffer layer patterning. By using CBD method, it was observed that ZnO nanorods were densely grown on the surface of CNTC. The nanorods diameter and length increased proportionally to the increased of buffer layer thickness. The highest aspect ratio is 9.21 corresponds to the highest synthesis temperature of 120°C at seed layer thickness of 81.6 nm. Results shows that ZnO crystal size increased corresponded to the increased of temperature. The result showed that high temperature influenced the morphology of ZnO nanostructures grown on CNTC. The ZnO nanorods on CNTC is comparable to those grown on another substrate such as glass and alumina. CNTC is found to be a better substrate as it is flexible, readily available, low cost and could act as charges carrier transport than other substrates. The characterizations of the hybrid material showed promising potentials that can be further explored in the application of small-scale electronics devices, sensors and energy harvester.

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