Hygroscopicity enhancement of low temperature hydrothermally synthesized zinc oxide nanostructure with heterocyclic organic compound for humidity sensitization

ABSTRACT

Materials that have hygroscopic capabilities are potent sensing elements for humidity sensors. The hygroscopic behaviour of zinc oxide (ZnO) with modified nanostructure was synthesized and characterized. Heterocyclic additive was added on ZnO to improve its hygroscopic capability for humidity sensitization. ZnO capability of water molecule adsorption was tested with a hygroscopic characterization method adapted from American Society for Testing and Materials (ASTM) method for hygroscopic determination. It was found that inclusion of additive improves the water retention and release ZnO, making it more viable for use in sensors that take advantage of mechanical strain due to weight for humidity determination. The hygroscopic behaviour was observed in the steeper gradient on the mass change during humidity exposure to the ZnO compound with the additive compared to non-additive ZnO. Furthermore, the additive loaded ZnO showed greater reliable regression, R2 value (3.56 %) compared to the non-additive ZnO sample. Crystal analysis via X-ray diffraction (XRD) revealed increment on ZnO characteristic peaks (002) and (101) upon addition of the organic compound to the ZnO which influence the nanostructure of the material. Field emission scanning electron microscopy (FESEM) indicates porous and hemispherical nanostructure. Elemental analysis showed minimal impurities present on both ZnO and additive loaded ZnO. The hygroscopic capabilities of ZnO synthesized with low temperature hydrothermal technique allows for implementation in many humidity sensing options required by industries of various fields.

Keyword: Additives; Humidity; Hydrothermal; Hygroscopic; Zinc oxide