MODELLING AND SIMULATION OF PIEZOELECTRIC NANOGENERATOR USING ZINC OXIDE FOR WEARABLE ELECTRONICS

Vithusan T, Nashira M.N.F, S.U Adikary*

Department of Materials Science and Engineering, University of Moratuwa, Sri Lanka

**Email: suadi@uom.lk*

A vertically integrated Zinc Oxide nanowire (NW) based piezoelectric nanogenerator (NG) was modelled for energy harvesting applications. Nanogenerators were modelled on unit element based and arrays based and were simulated using COMSOL Multiphysics 5.3 and the mathematical equations were derived considering the coupled piezoelectric and mechanical behaviour. Moreover, the voltage output of the single NW under a constant lateral force was analysed varying with the NW dimensions in terms of aspect ratio. The results showed that the compression of ZnO NW gives more output voltage compared to the bending of the NW for the same NG. The stress variation was analysed for the range of nanowire dimensions (aspect ratio) using the software. The influence of aspect ratio, length, and diameter on the output electrical potential of the ZnO nano wire-based NG was investigated using simulated results. It was observed that when the diameter is increasing along with the aspect ratio decreasing for constant length, electrical potentials at the output decrease. The aspect ratio was analysed by maintaining a constant dimeter and with variable length. When the length is increasing along with the aspect ratio, the voltage output shows lesser deviation. The theoretical and simulation results also proved that the length of the NW does not influence the piezoelectric potential in a lateral bent NW. The unit element and then the integrated array design with PMMA filler and insulator were modelled by assembling such 9x9 (81) unit elements with the inter wire distance of 40nm and the results were analysed.

Keywords: