Notification No: 571/2024

Date of Award: 06-12-2024

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**Topic of Research: Synthesis and Characterization of Carbon Nano-Tubes and its Applications for Electronic Devices**

## Finding

The research has provided significant insights into the synthesis and characterization of CNTs with enhanced field emission (FE) properties. Using a variety of strategies to maximise their performance, the study concentrated on the development and enhancement of CNTs for application in field emitter devices. The LPCVD process was used to create MWCNTs, with a focus on regulating the growth conditions to provide the required structural and morphological properties. The results showed that by altering the length and diameter of CNTs, the double catalyst deposition method—which makes use of combinations like Fe/Al, Fe/Ag, and Ni/Ti—played a crucial part in improving the aspect ratio of the particles. Improved field emission properties, such as lower turn-on and threshold fields and higher emission current density, were made possible in large part by this optimisation.

The synthesised CNTs' surface shape and structural integrity were carefully assessed using Raman spectroscopy and FESEM analysis. While the D and G bands revealed information about the defect density and graphitic quality, the absence of RBM peaks in Raman spectra verified the creation of MWCNTs. The Fowler-Nordheim (FN) model was used to study the field emission behaviour in detail, and the results showed that CNTs synthesised with lower quantities of Fe in the catalyst performed better. Comparing these CNTs to ones produced with greater Fe concentrations, they showed lower turn-on and threshold fields and higher current densities.

By attaching ZnO nanoparticles to the CNTs, the field emission characteristics were further improved. The performance of the MWCNTs was greatly affected by the ZnO coating that was applied using the RF sputtering approach at different deposition periods. With its low turn-on voltage, high current density, and exceptional stability over long periods of time, the

ZnO(4)/MWCNTs field emitter was found to be the most effective. The enhanced electron emission site density and the edge effect brought about by the ZnO ornamentation were credited with the better emission behaviour.

The study investigated the creation of MOF-based composite field emitters in addition to ZnO ornamentation. The study showed a new method for improving field emission characteristics by incorporating ZnO and MWCNTs into MOF frameworks. With a high emission current density of 219.15 mA/cm2 and a low turn-on electric field of 0.50 V/μm, the resultant ZnO@MOF/MWCNTs composite demonstrated remarkable performance. This increase was attributed to the composite's special structural arrangement, which offered improved electrical conductivity, a low surface work function, and a high density of electroactive sites.

All things considered, the study made clear how crucial it is to optimise the synthesis parameters and add new composite materials in order to enhance the field emission characteristics of CNTs. The results highlight the potential of CNT-based field emitters for a range of technical uses, such as electron microscopes, field emission displays, and other nanoelectronic devices. The work has cleared the path for the creation of dependable and effective CNT-based field emission devices by using cutting-edge techniques including metal oxide decorating, double catalyst deposition, and MOF composites.