

SEMINAR

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Optimization of Bi_2O_3 -doped ZnO-based varistors using Artificial Neural Networks

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Zinc oxide (ZnO)-based varistors are widely used for protection against transient overvoltages due to their highly nonlinear current–voltage characteristics. This study investigates the combined effects of oxide dopants on the nonlinear coefficient α and applies artificial neural networks (ANNs) to optimise their compositions. Using 400 experimental results, two dopant groups were examined: the most influential oxides (MnO_2 , NiO , Ce_2O_3 , La_2O_3) and the least influential oxides (Cr_2O_3 , Co_3O_4 , Nb_2O_5), with Bi_2O_3 evaluated in both systems. Two-layer feedforward neural-network models were developed using dopant concentrations as inputs and α as the output. The optimized models showed excellent agreement between experimental and predicted values, with correlation coefficients close to unity. The best performance was achieved for the composition containing MnO_2 , NiO , Ce_2O_3 , La_2O_3 , and Bi_2O_3 , yielding an experimental of 126.06 and a predicted value of 126.20 ($R=0.9994$). For the second group, the optimised composition with Cr_2O_3 , Co_3O_4 , Nb_2O_5 , and Bi_2O_3 reached an experimental value of 120.93 and a predicted value of 121.07 ($R=0.9998$). These results confirm the synergistic role of Bi_2O_3 in enhancing nonlinearity and demonstrate that ANN modelling is an effective tool for optimizing ZnO-based varistors.

Kindly invited.