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Modeling of Schottky diode characteristic by machine learning techniques based on experimental data with wide temperature range

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Highlights

- Temperature-dependent I–V characterization of Au/Ni/n-GaN/undoped GaN Schottky diode.
- Experimentally obtained data set within the 40K-400K temperature range with 20K steps.
- Modeling of I–V characterization Schottky diode with ANFIS, ANN, SVR, and GPR.
- Assessment of modeling performances with 20K temperature steps.

Abstract

In this study, 4 common machine learning methods have been used to model the I–V characteristic of the Au/Ni/n-GaN/undoped GaN Schottky diode. The current values of previously produced Au/Ni/n-GaN/undoped GaN Schottky diode against the voltages applied to the diode terminal starting from the temperature of 40K up to 400K with 20K steps were measured. Models were created using Adaptive Neuro Fuzzy System, Artificial Neural Network, Support Vector Regression, and Gaussian Process Regression techniques using experimental data containing 5192 samples in total. After determining the combinations and specifications for each one that provide the lowest model error of each model, the performances of the obtained models were compared with each other concerning the various performance indices. The performance of the ANFIS model was found to be much better than the others in both the learning and test phases with RMSE model errors as 6.231e-06 and 6.806e-06, respectively. Therefore, it was proposed as a powerful tool for modeling I–V characteristics at all temperature values between 40K and 400K.

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Keywords

Machine learning; Schottky diode; Temperature based I–V characteristic