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Artificial Neural Networks for the Prediction of Plasma Nitration Results

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Plasma nitriding is a state-of-the-art thermochemical treatment, which the processing industry uses for hardening of the surface layer of tools and components. In the past, the potential to generate optimal results was not fully exploited. For this purpose, a prediction tool which calculates appropriate nitriding parameters adapted for the required properties of the component or tool is to be developed. The aim is to perform optimized nitriding treatments taking into account for example the chemical composition, hardness and nitriding depth.
The prediction tool uses artificial neural networks (ANN). ANN usually consist of neurons which are connected and combined in an input layer, hidden layer and output layer. In order to train the network, the weight distribution of the connections, the number of hidden neurons and the neuron activation functions are varied. The aim of the ANN is to generate an output of different simulated hardness profiles depending on the chemical composition of the steel and the process parameters. In order to test the network, real-life trial results that are not incorporated into the training of the network will be used to confirm the results. This shows the accuracy of the prediction. The data base for the calculations and the training of the prediction tool are 42 variants of different nitriding processes. These are carried out using 12 different steels that differ fundamentally in their chemical composition. The composition and the process parameters have a decisive influence on the nitriding result. This generates varying hardness depth profiles in regards to the type of hardness gradient, surface hardness and the nitriding hardness depth. The data provided is used for initial training of the artificial neural network and evaluation of the predictions. Additionally, microstructural investigations enable for further analysis.

Keywords
plasma diffusion treatment
artificial neural network