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Optimization of Etching Recipe Using Deep Neural Network YUTAKA OKUYAMA, TAKESHI OHMORI, HYAKKA NAKADA, MASARU KURIHARA, Hitachi Ltd., Research Development Group — Increasing the number of control parameters in etchers has achieved nanoscale semiconductor processing. However, optimizing etching recipes with such a large number of parameters has made it difficult to obtain a desirable profile. In this work, a deep neural network (DNN) [1] has been applied to predict etching recipes for vertical trench etching. Training data consisted of seven input parameters in an etching recipe and nine output parameters representing a trench profile, and 82 samples which had no vertical trench were prepared as an initial dataset. Several target profiles were set to exceed the best profile in the dataset and gradually approach a deep vertical trench. The predicted recipes for these targets were verified by etching experiments, and these results were used to update the training dataset. An optimization cycle consisting of training, prediction, verification, updating the dataset, and updating targets to a depth exceeding 1000 nm was repeated. The vertical trench was realized in the fourth cycle with 102 samples. Our recipe prediction method was found to be very effective in searching for the optimum recipe and applicable in obtaining desirable results in semiconductor manufacturing tools. [1] I. Goodfellow, Deep Learning, MIT Press, 2016.

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