Wan Sik Nam, J Data Mining In Genomics & Proteomics 2015, 6:4
http://dx.doi.org/10.4172/2153-0602.C1.003

OMICS International
conferenceseries.com

2nd International Conference on
Big Data Analysis and Data Mining
November 30-December 01, 2015 San Antonio, USA

Wafer yield prediction based on virtual metrology process parameters in semiconductor manufacturing

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Yield prediction is one of the most important issues in semiconductor manufacturing. Especially, for a fast-changing environment of the semiconductor industry, accurate and reliable prediction techniques are required. In this study, we propose a procedure to predict wafer yield using quality variables generated from the virtual metrology (VM) model of the semiconductor fabrication. A number of process variables that reflect tools' conditions, such as power, temperature, and flow rate, can be collected from sensors attached to the tools. The quality variable can be measured from sampled wafers by metrology equipment. From the relationship between the process variables and the quality variable, a VM model can be constructed to predict the outcomes of the quality variable from unsampled wafers. Thus, the VM model enables us to obtain the information of quality variables for all wafers. Consequently, we were able to construct the yield prediction model that characterizes the relationship between the quality variables and wafer yield for all wafers. The effectiveness and applicability of the proposed VM-based yield prediction model were demonstrated through a real data from a leading semiconductor industry in South Korea. We constructed the proposed prediction models based on various machine learning algorithms (multiple regression, ridge, elastic net, lasso, fused lasso, support vector machine, decision trees, random forests) and compared them in terms of several performance measures. We found that the prediction model based on the support vector machine algorithm yielded better prediction accuracy than others. To the best our knowledge, this study is the first attempt to construct the yield prediction model based on the process variable generated from the VM model.

Biography

Wan Sik Nam is currently pursuing an MS degree from the School of Industrial Management Engineering, Korea University and is working for Samsung Electronics company as a Semiconductor Manufacturing Engineer. His research interests include the yield prediction model of a semiconductor product that is capable of predicting the wafer yield using the variables generated from the virtual metrology in the semiconductor manufacturing.

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