Correction Model for Photoresist Shrinkage in CD-SEM Metrology Based on ISWO-SVR

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Continuous advances in semiconductor manufacturing have led to ever-shrinking integrated circuit feature sizes, imposing increasingly stringent requirements on photolithography process control[1]. However, measurements by critical dimension scanning electron microscopes (CD-SEMs) are prone to errors due to photoresist shrinkage induced by electron beam irradiation. To address this issue, a machine learning-based predictive model is proposed to recover the true, pre-shrinkage critical dimensions of the photoresist, thereby enhancing CD-SEM measurement precision. The overall framework of this study is shown in Figure 1. First, the required training and test sets are obtained using CD-SEM and AFM. Then, a good-point set based population initialization strategy, cyclic population reduction, and a dynamic tradeoff rate are used to improve the spider wasp optimizer[2] (ISWO). The ISWO is used to optimize the hyperparameters of a support vector regression[3] (SVR) model, enhancing its regression performance in predicting the photoresist shrinkage phenomenon. Finally, the superiority of the model is verified by comparing the MSE, MAE, MAPE, and values obtained using ISWO-SVR with those from other methods. Experimental results indicate that the ISWO exhibits superior optimization capabilities, and the ISWO-SVR model significantly outperforms conventional methods in predicting the original critical dimensions, yielding improved accuracy and stability. The study provides a novel and efficient methodology for mitigating measurement deviations induced by photoresist shrinkage in CD-SEM applications.

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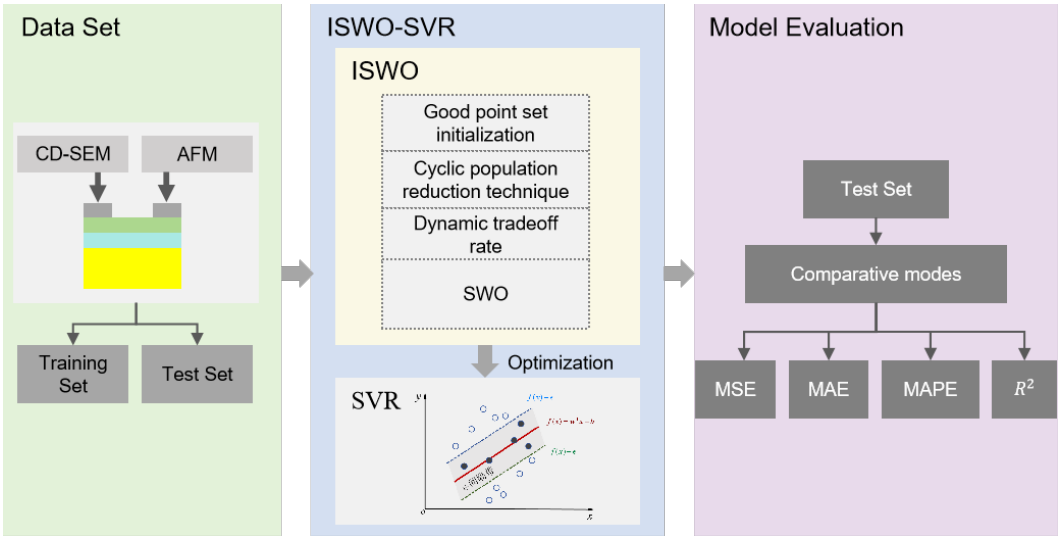

*Figure 1:*The overall framework of ISWO-SVR