# CMP removal rate and profile prediction via deep learning-based algorithm for robust process design

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With the shrinkage of the minimum feature size on semi-conductor manufacturing, chemical mechanical polishing (CMP) technology has been a key process to achieve a great surface planarization which is directly related with its integrated circuit (IC) performances. In CMP process development, thus, considering factors such as integration and equipment dependent variables over understanding physical/chemical mechanisms of CMP itself will be crucial for the CMP process design aiming next generation devices [1].

There are various parameters existed which can affect the CMP removal, then the understanding the complex mechanism over those parameters is a quite difficult to solve. In recent years, one of most disruptive technology in engineering field is a smart engineering oriented machine/deep learning algorithm. Applying these artificial intelligence (AI) algorithms to CMP fields, we can predict or classify the mechanisms which is hard to calculate by an engineer.

This paper proposes the deep learning-driven CMP removal rate (RR) and profile prediction modeling with big data-based approaches. Artificial neural network (ANN) is employed to predict the CMP RR and its removal profile on non-patterned wafer and the most of CMP process parameters are applied as input variables to obtain a precise prediction result. In this paper, we firstly address CMP RR profile prediction driven by deep learning technology with a validation accuracy of 93% for averaged RR prediction and over 70% for CMP removal profile forecasting.

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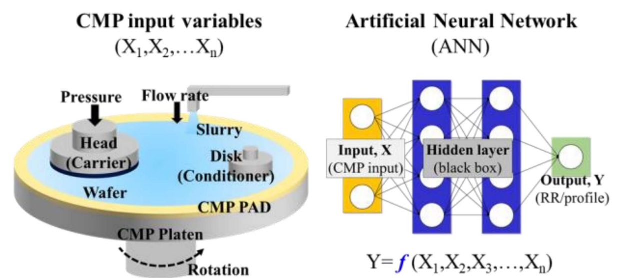


**Fig.1** CMP schematics with multi input parameters (left) and a CMP removal prediction algorithms driven by artificial neural network (right).

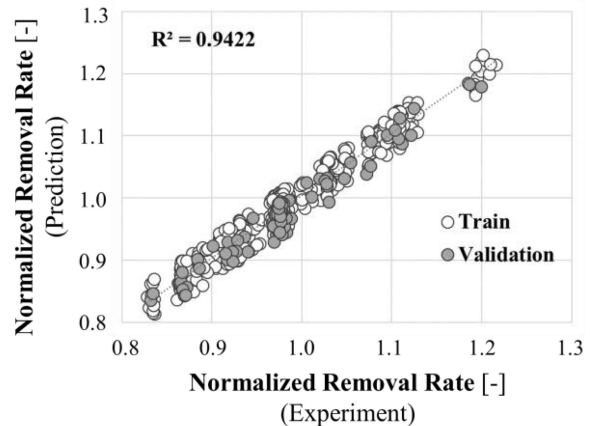


**Fig.2** Averaged RR prediction result over 500 polished non-patterned wafer with a validation accuracy of 94%.

[1] H. Kim et al., “Mathematical modeling based on contact mechanism due to elastic and plastic deformation of pad asperities during CMP”, Journal of Mechanical Science and Technology, 34 (2020), pp. 289-300

Preference: ■ Oral ☐ Poster

Topic Area: CMP fundamentals, modeling, and simulation