A MACHINE LEARNING-BASED APPROACH FOR QUALITY CONTROL OF CHEMICAL MECHANICAL PLANARIZATION PROCESS

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Chemical–mechanical polishing (CMP) allows the device manufacturer to achieve global planarization of the entire wafer surface in a single step. However, the complexity of the overall process and the different removal rates between metal and dielectric areas lead to well-known defects in the interconnect structures, the most relevant ones being dishing and erosion. Controlling these interconnect defects by changing slurry quality is becoming increasingly complicated since interconnect dimensions are being aggressively reduced in new technology nodes. Interconnect widths are now well below 40 nm for many of the metallization levels in both logic and memory devices. At this point, detecting slurry variations due to quality issues is extremely difficult by only using traditional physical characterization techniques such as Atomic Force Microscopy (AFM) or Scanning Electron Microscopy (SEM) cross-section.

Hence, in this work, we have created a Machine Learning based model (Fig. 1) to correlate the electrical response with the effect of polishing defects such as dishing and erosion. The model is fed with the line width and pitch of the interconnect on the test vehicle, topographical data, and electrical data. Once trained, the model maps the post-CMP physical characteristics of the interconnect to its electrical characteristics (Fig. 2). The predictive model developed here could be used to optimize slurry formulation to align with the dishing and removal rate expectations and ultimately deliver desired electrical behavior from the interconnect.

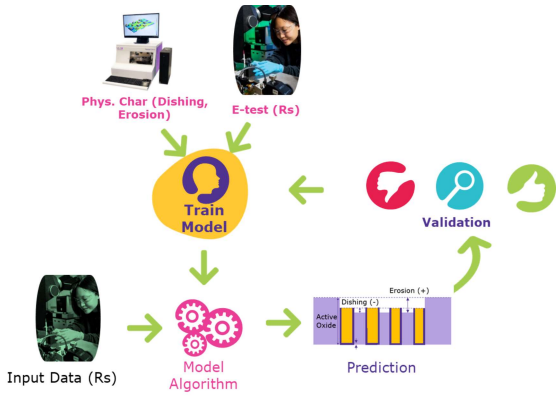

Fig.1 Model creation workflow

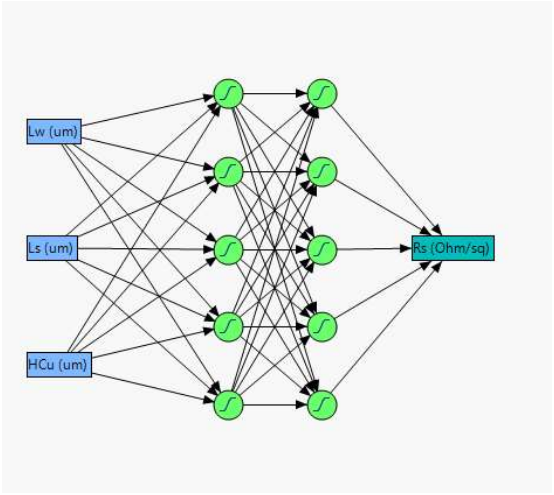

Fig.2 Neural Network Model

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