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Modeling and Simulation of Pad Surface Topography by Diamond Dressing in Chemical-Mechanical Polishing Process

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Abstract : Chemical-mechanical polishing (CMP) process has been widely applied on fabricating integrated circuits (IC) with a soft polishing pad combined with slurry composed of micron or nano-scaled abrasives for generating chemical reaction to remove substrate or film materials from wafer. During CMP process, pad uniformity usually works as a datum surface of wafer planarization and pad asperities can dominate the microscopic pad-slurry-wafer interaction. However, pad topography can be changed by related mechanism factors of CMP and it needs to be re-conditioned or dressed by a diamond dresser of well-distributed diamond grits on a disc surface. It is still very complicated to analyze and understand kinematic of diamond dressing process under the effects of input variables including oscillatory of diamond dresser and rotation speed ratio between the pad and the diamond dresser. This paper has developed a generic geometric model to clarify the kinematic modeling of diamond dressing processes such as dresser/pad motion, pad cutting locus, the relative velocity of the diamond abrasive grits on pad surface, and overlap of cutting for prediction of pad surface topography. Simulation results focus on comparing and analysis kinematics of the diamond dressing on certain CMP tools. Results have shown the significant parameters for diamond dressing process and also discussed. Future study can apply on diamond dresser design and experimental verification of pad dressing process.

Keywords : kinematic modeling, diamond dresser, pad cutting locus, CMP
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