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Mathematical Modeling of the AMCs Cross-Contamination Removal in the FOUPs: Finite Element Formulation and Application in FOUP's Decontamination

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Abstract : Nowadays, with the increasing of the wafer's size and the decreasing of critical size of integrated circuit manufacturing in modern high-tech, microelectronics industry needs a maximum attention to challenge the contamination control. The move to 300 mm is accompanied by the use of Front Opening Unified Pods for wafer and his storage. In these pods an airborne cross contamination may occur between wafers and the pods. A predictive approach using modeling and computational methods is very powerful method to understand and qualify the AMCs cross contamination processes. This work investigates the required numerical tools which are employed in order to study the AMCs cross-contamination transfer phenomena between wafers and FOUPs. Numerical optimization and finite element formulation in transient analysis were established. Analytical solution of one dimensional problem was developed and the calibration process of physical constants was performed. The least square distance between the model (analytical 1D solution) and the experimental data are minimized. The behavior of the AMCs intransient analysis was determined. The model framework preserves the classical forms of the diffusion and convection-diffusion equations and yields to consistent form of the Fick's law. The adsorption process and the surface roughness effect were also traduced as a boundary condition using the switch condition Dirichlet to Neumann and the interface condition. The methodology is applied, first using the optimization methods with analytical solution to define physical constants, and second using finite element method including adsorption kinetic and the switch of Dirichlet to Neumann condition.

Keywords : AMCs, FOUP, cross-contamination, adsorption, diffusion, numerical analysis, wafers, Dirichlet to Neumann, finite elements methods, Fick's law, optimization
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