Part V
Modeling

Part V presents the modeling of superconformal electrodeposition for the application in the ULSI interconnect technology. Superconformal electrodeposition enables the void-free filling of high aspect ratio features such as trenches or vias in the Damascene metallization process. Superconformal electrodeposition, also known as superfill, occurs when particular combinations of chemical additives are included in an electrolyte. The additives enable preferential metal deposition at the bottom surface of the feature, which leads to "bottom-up" filling before the side walls close off, avoiding the formation of voids or seams in the feature. In order to predict and characterize this behavior, governing equations must be derived and solved. In general, this requires the numerical solution of a coupled set of partial differential equations (PDEs) for a full description. FiPy is an open source, PDE solver that has been used to numerically solve the superfill problem. It is written in Python and based on a standard finite volume approach. FiPy includes numerical algorithms that track moving and deforming interfaces, such as an electrode–electrolyte interface, that commonly occur in materials science problems. The chapter will begin with a broad introduction to gap-fill modeling with particular emphasis on the superfill process. Next, the governing equations will be introduced followed by the numerical aspects of interface tracking for the superfill problem. Finally, a description of how to use FiPy for solving the superfill problem will be given with an example.