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On the comparison between fitted and unfitted finite element methods for the approximation of void electromigration

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Abstract

Microelectronic circuits usually contain small voids or cracks, and if those defects are large enough to sever the line, they cause an open circuit. Two fully practical finite element methods for the temporal analysis of the migration of voids in the presence of surface diffusion and electric loading are presented. We simulate a bulk-interface coupled system, with a moving interface governed by a fourth-order geometric evolution equation and a bulk where the electric potential is computed. A *fitted* approach (where the interface grid is always extracted from the boundary of the bulk grid) and an *unfitted* approach (where there is no perfect matching between the two grids) are analysed. A comparison between the two methods, in terms of experimental order of convergence (when the exact solution to free boundary problem is known), CPU time, and coupling operations (e.g., smoothing/re-meshing of the grids, intersection between elements of the two grids), is presented in detail. Several numerical simulations are performed in order to test the accuracy of the methods.

Key words: void electromigration, fitted, unfitted, finite element methods, re-meshing, smoothing.