Thin-Film Models of Liquid Displacement on Chemically Patterned Surfaces for Lithographic Printing Processes

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We examine in this work a model problem relevant to the liquid displacement that occurs in lithographic printing processes. The model problem consists of two stratified thin liquid films confined between parallel plates, one of which is chemically heterogeneous. The films are assumed to be thin enough so that intermolecular forces are important and the lubrication approximation can be invoked. Both linear stability analysis and nonlinear simulations are applied to a partial differential equation governing the behavior of the liquid-liquid interface. The results provide physical insights into and numerical estimates of the smallest and largest feature sizes that can be printed, as well as the minimum spacing between feature sizes that can be tolerated. The results also provide insight into experimental observations on a closely related process, wire-wound rod coating on chemically patterned surfaces. The work presented here has important implications for the production of electronic devices and displays by lithographic printing, as well as for other processes that rely on coating and printing on chemically patterned surfaces.

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