503f Predictive Control of Thin Film Deposition Using Stochastic Pdes

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This talk will discuss recent results on the construction of a 2-dimensional (2D) stochastic partial differential equation (PDE) model for a thin film deposition process and the design of a multivariable predictive controller based on the constructed model to control thin film thickness and surface roughness. Specifically, we focus on a thin film deposition process governed by three microscopic processes including molecule adsorption, migration and desorption. A 2D linear stochastic PDE model is initially constructed following a systematic model construction procedure that we recently proposed based on data obtained by a kinetic Monte-Carlo simulator of the process. Then, a multivariable predictive controller is designed using appropriate finite-dimensional approximations of the stochastic PDE model. The control problem is formulated as a predictive control problem, in which the finite-dimensional model is used to predict both the thin film thickness and the surface roughness. The model-based predictive controller is applied to the kinetic Monte-Carlo (kMC) simulation of the deposition process to simultaneously control the thin film thickness and surface roughness in the presence of manipulated input and state variable constraints. Closed-loop system simulation results demonstrate that the model is adequately accurate and that the controller is effective.