Sputter processes: Neural network based modeling and control

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Sputter processes facilitate the deposition of thin layers on a solid by a low-pressure plasma. Industrial applications are the fabrication of optical reflective layers, superconductive layers, hard coatings and integrated circuits.

In the first part of the talk a control-oriented model of sputter processes based on artificial neural networks and ordinary differential equations is proposed. The physical processes are represented by analytical models of the process subsystems to approximate a suitable structure for a plant model. Since the plant includes asymmetries, a magnetically enhanced plasma and device-specific characteristics, the model structure partly consists of black boxes. Hence, an experimental identification of the unknown model parts by the training of artificial neural networks and time constants is proceeded. The model shall accurately describe the input/output behavior of the process and shall close the gap between the quantitative partial differential equation models and the qualitative analytical models. Experiments for the validation of the developed process model are shown.

In the second part of the talk a control design method for sputter processes is presented. The multiple-input (argon flow, valve position, generator power) multiple-output (argon pressure, bias voltage) plant is decoupled and linearized by artificial neural networks and a gain-scheduled controller. Decentralized linear controllers are used to achieve set-point following. Experiments are shown for the controller validation.