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# Artificial Neural Networks as Plasma-Surface Interface for Sputtering and Gas-Phase Transport Simulations

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Thin film processing by means of sputter deposition inherently depends on the particle interaction at the target surface and the subsequent transport of film forming species through the plasma. The length and time scales of the underlying physical phenomena span orders of magnitudes. A theoretical description which bridges all time and length scales is not practically possible. A unified approach which describes the dynamics of both the solid and the gas-phase, however, remains desired. In fact, advantage can be taken particularly from the well separated time scales of the fundamental surface and plasma processes by evaluating both independently. Initially, the surface properties may be a priori calculated and stored. Subsequently, the data may be provided to particle transport simulation models via appropriate interfaces (e.g., analytic expressions or look-up tables) and utilized to define insertion boundary conditions. Specifying accurate and computationally feasible interfaces in cases which involve only a few species (e.g., argon and metal) is straightforward. More complex surface and gas compositions, i.e., a higher order parameter space, complicate the interface models substantially. In this work, a potential remedy is demonstrated based on artificial neural networks (ANNs) [1,2]. As a proof of concept, a multilayer perceptron (MLP) is trained and verified with sputtered particle energy and angular distributions obtained from TRIDYN simulations [3] for Ar, Al, and Ti projectiles bombarding an Al-Ti composite. Subsequently, the trained network is used to predict the sputtering dynamics for arbitrary incident ion energy distributions. Consequently, the sputtered particle energy and angular distribution may be sampled quasi-continuously and to a sufficient accuracy also in scenarios which have not been previously trained.

**Keywords**
Plasma surface interaction