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Modeling the time dependency of the reactive sputter process

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When adding a reactive gas (like oxygen or nitrogen) to the sputter process, a wealth of new technological opportunities arises. Nevertheless the inclusion of this reactive species introduces a so-called poisoning mechanism of the target which seriously decreases the deposition rate. As the transition to the poisoned mode typically evolves in a timescale of seconds up to minutes, which is slow compared to discharge related processes, the use of time-expensive detailed codes should be avoided. An accurate and fast model which describes the time dependency of this poisoning effect is therefore needed.
A non-stationary RSD (Reactive Sputter Deposition) model is therefore proposed. It is based on a stationary version which was already applied in earlier work [1]. The present model includes the following poisoning mechanisms: chemisorption, direct and knock-on reactive ion implantation, and redeposition of sputtered material on the target. This model [2] is reinforced with a more detailed input from a plasma model which accounts for the changing target condition and the reactive gas content. This will result in a time evolution of the bombarding reactive ion distribution. Combined with the SIMTRA package [3] and SRIM [4], this gives us a strong tool to investigate the time evolution and the mechanisms of the target poisoning.
As feedback to the RSD model, the simulated time evolution is compared to the experimental one for a planar DC magnetron. This will show the necessity of including additional physical processes like diffusion, an accurate model of existing aspects like implantation, or the correctness of the physical parameters defining the system.
References:
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Keywords
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