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Progress in HiPIMS modeling

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High power impulse magnetron sputtering (HiPIMS) is a promising sputtering-based ionized physical vapor deposition (IPVD) technique known to generate highly dense plasma discharges. A large fraction of the sputtered material is thereby ionized, providing new and added means for the synthesis of tailor-made thin films. Although much experimental work has been carried out during the last decade to reveal the various physical mechanisms operating in HiPIMS, still many questions remain, in particular how to optimize this technique for different coating recipes. One route towards better understanding of HiPIMS is through computational modeling. It has the possibility to test mechanisms separately, which rarely can be done experimentally, and upon successful benchmarking unify already existing descriptions into a general description of the coating process, which is far more useful for practical purposes. In this talk we give an overview of recent results achieved using various HiPIMS models, which are compared to experimental measurements. Examples are monitoring important plasma processes in the ionization region such as electron impact excitation and ionization, gas rarefaction, gas diffusion, etc., using a global model [1], as well as studying the transport of sputtered material by Monte Carlo and PIC simulations. We also put focus on specific areas of interest in HiPIMS where we believe modeling can make substantial contributions. An outline of challenging tasks, such as optimization of reactive HiPIMS, inclusion of spokes formation into the models, and understanding the influence of the B-field strength on the deposition rate, will be presented along with a roadmap on suggestions how to tackle them.
References
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