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**What can we learn about HiPIMS process from the multidimensional plasma modeling?**<sup>1</sup>

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The modeling of PVD process and especially magnetron plasma is widely reported. The novel way to excite the plasma applying to the cathode very high power pulses brings the temporal dimension to the system together with new phenomena. From the kinetic model of the dense plasma region, so called Ionization Region – IR, one can quantify the global behavior of the plasma parameters during the pulse. The most significant are the plasma composition, especially in the case of reactive gases, the fraction of back-attracted sputtered ions, the rarefaction due to wind effect, but also the discharge heating mechanisms and contribution to the discharge current. From the 2D particle modeling of the plasma new insights are revealed concerning the shape of the dense plasma region, the time evolution of the sheath, the electron energy distribution function, but also the characteristics of the diffusion plasma facing the substrate. Adding the third dimension to the model, the results reveal the complex transport of electrons especially in the azimuthal direction (instabilities and drifts), the formation of spokes and flares, and the strong relation between the secondary emission of electrons from the target and the plasma structuring.

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