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INVITED TALK

To be presented at the
9th International Workshop on Plasma Based Ion Implantation and Deposition
PBII&D 2007
Leipzig, Germany, September 2-6, 2007

PHYSICS OF HIGH POWER IMPULSE MAGNETRON SPUTTERING AND PLASMA-BASED ION IMPLANTATION & DEPOSITION: A COMPARISON

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Abstract April 10, 2007

This work was supported by the Assistant Secretary for Energy Efficiency and Renewable Energy, Office of Building Technology, of the U.S. Department of Energy under Contract No. DE-AC02-05CH11231.

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The emerging technology of High Power Impulse Magnetron Sputtering (HIPIMS) and Plasma Based Ion Implantation & Deposition (PBIID) have much in common: both use pulsed plasmas, the pulsed sheath periodically evolves and collapses, the plasma-sheath system interacts with the pulse-driving power supply, the plasma parameters are affected by the power dissipated, etc. Therefore, both fields of science and technology could learn from each other, which has not been fully explored. On the other hand, there are significant differences, too. Most importantly, the operation of HIPIMS heavily relies on the presence of a strong permanent magnetic field, confining electrons and causing their **E**x**B** drift, which is closed for typical magnetron configurations. Second, at the high peak power levels used for HIPIMS, 1 kW/cm^2 or greater averaged over the target area, the sputtered material greatly affects the plasma generation. In contrast, plasma generation and ion processing of the surface (implantation, ion etching, and deposition) are considered relatively independent processes. Third, secondary electron emission, generally considered a nuisance for PBIID, especially at high voltages, is a critical ingredient to smooth operation of HIPIMS. Fourth, the voltages in PBIID are often higher than in HIPIMS. For the first three reasons listed above, modeling of PBIID seems to be easier and could give some guidance for future HIPIMS models, which, clearly, will be more involved.