
Convergence of Plasma-Based Ion Implantation and Deposition Techniques (Plenary talk)

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Abstract

In this Plenary Talk, a panoramic view is given starting with the interesting and educational history of Plasma-Based Ion Implantation and Deposition (PBIID) and ending with modern applications in electronics and medical device engineering. Important subjects and milestones are covered including plasma nitriding, ultra-shallow layer formation, and the use of condensable (metal) plasmas for the synthesis of layers with controlled composition and microstructure. The principal idea of PBII, still without the "D" for deposition, was the elimination of a dedicated (current-limited) ion source by using the substrate surface as part of the ion extraction and acceleration arrangement. This required a re-interpretation of the Child-Langmuir law and led to a greater development of the theory of dynamic sheaths. The high energy limit of PBII was found as energy losses and x-ray generation became intolerable at voltages (about 100 kV). In the other extreme, using relatively low bias voltage, the PBIID techniques converge with techniques developed independently of PBIID. Specifically, technologically relevant, new developments in the context of high power impulse magnetron sputtering (HiPIMS) make use of biasing techniques that were originally developed for PBIID with pulsed arc and pulsed laser plasmas. In contrast to the early work, done some 20 or so years ago, the field enjoys today much greater availability of commercial power supplies, data acquisition, and materials characterization tools. The fundamentals and applications of today's PBIID suggest that there is an overall convergence of PBIID theory, hardware, and application with other plasma technologies that aim to modify surfaces, synthesize materials, and form thin films.

Keywords: PBII&D, review, arc plasma, HiPIMS plasma, biasing

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