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Ion Plating and Beyond: Pushing the Limits of Energetic Deposition

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The synthesis of films and coatings from ions have been practiced for decades. Not until recently, the high demands on film properties have increased the urgency for a deeper understanding of energetic deposition processes. There exists a variety of energetic processes which involve either plasmas, or low-energy ion beams, or both. Of particular interest are hybrid processes such as plasma immersion techniques that have several energy and species “knobs” to tune and tailor properties of coatings, graded layers, and multilayers. These processes will be briefly reviewed. Examples will be discussed where pulsed bias and fully ionized plasmas are used. Increasing the energy of condensing species leads to the formation of intermixed layers, usually accompanied with improved adhesion. Energetic deposition often leads to high compressive stress however, stress relieve can be obtained under certain conditions, especially when using high-energy particle fraction is dictated, among other factors, by the average power limits, temperature tolerance of the substrate, and the effect of resputtering from the growing film. Finally, the energy balance of surface region is discussed considering kinetic and potential energy of the arriving species.