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Publication Date
2005-01-02
INVITED TALK

Presented at the International Conference on
Surface Modification of Material by Ion Beams (SMMIB)

Kusadasi, Turkey, September 4-9, 2005

Energetic Condensation of Metal Plasmas

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Abstract: January 2, 2005

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This work was supported by the U.S. Department of Energy under Contract No. DE-AC02-05CH11231.
Metal plasmas play a special role in the formation of coatings because metal ions are condensable (film forming) and bias can be efficiently applied. In contrast to conventional ion-beam-assisted deposition, no external ion (beam) source is needed, and substrate bias is acting directly on film-forming species. Both ion implantation and deposition has been demonstrated. Related techniques are discussed, known as ion plating (IP), arc-bond-sputtering (ABS), and metal plasma immersion ion implantation and deposition (MePIIID). Metal plasmas obtained by filtered cathodic vacuum arcs (FCVA) and by high-power pulsed sputtering (HPPS, also HIPIMPS) are of special interest. Using these techniques, special features can be utilized, including substrate-film interface tailoring, film densification, and stress control. Attention should be paid to less-than-one sticking coefficient and non-zero self-sputter yield, which will be explained. Such features are of great importance to nano-size filling of three-dimensional structures and to ion-neutral interaction in the plasma, affecting ion charge states and the energy of ions arriving at the substrate.