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# MACRO-PARTICLE FREE METAL PLASMA IMMERSION ION IMPLANTATION AND / OR DEPOSITION.

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High energy implantation of metal ions can be carried out using conventional ion implantation with a mass-selected ion beam in a scanned-spot mode, employing a broad-beam approach such as with a vacuum arc ion source, or utilizing plasma immersion ion implantation with metal plasma. For many high dose applications, the use of plasma immersion techniques offers a high-rate process, but the formation of a surface film along with the sub-surface implanted layer is sometimes a severe or even fatal detriment. We describe here an operating mode of the metal plasma immersion approach by means of which pure and macro-particle free implantation, pure deposition without ion implantation, and dynamic ion beam assisted deposition of metal and gaseous plasma ion immersion(DIBAD of metal and gaseous PII)can be obtained. We have demonstrated the technique by carrying out Ti and Ta implantation at energies of about 80 keV (Ti) and 120 keV (Ta) and doses on the order of $1 \times 10^{17}$ ions/cm$^{2}$. In our experiments, the Ta and Ti plasma immersion process gives rise to "pure" implantation with no accompanying surface film. Also the atomic fraction of the applied dose that deposits as a film versus the part that is energetically implanted during the DIBAD of metal and gaseous PII can be precisely controlled. This is a valuable method to make advanced materials.