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Performance of an inverted ion source

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Whereas energetic ion beams are conventionally produced by extracting ions (say, positive ions) from a plasma that is held at high (positive) potential, with ion energy determined by the potential drop through which the ions fall in the beam formation electrode system, in the device described here the plasma and its electronics are held at ground potential and the ion beam is formed and injected energetically into a space maintained at high (negative) potential. We refer to this configuration as an "inverted ion source." This approach allows considerable savings both technologically and economically, rendering feasible some ion beam applications, in particular small-scale ion implantation, that might otherwise not be possible for many researchers and laboratories. We have developed a device of this kind utilizing a metal vapor vacuum arc plasma source, and explored its operation and beam characteristics over a range of parameter variation. The downstream beam current has been measured as a function of extraction voltage (5–35 kV), arc current (50–230 A), metal ion species (Ti, Nb, Au), and extractor grid spacing and beamlet aperture size (3, 4, and 5 mm). The downstream ion beam current as measured by a magnetically-suppressed Faraday cup was up to as high as 600 mA, and with parametric variation quite similar to that found for the more conventional metal vapor vacuum arc ion source.

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