Surface production of negative ions by ions and atoms in the electron suppressor region

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Production of negative ions by positive ion and atom interactions with a low work function surface (namely caesium), is believed to provide a high fraction of the beam current in the sources currently proposed to meet ITER requirements.

In this paper we present a simple model of the production of negative ions by the impingement of positive ions and atoms from the source plasma on a caesiated surface. The model combines calculated flux rates for the ions and atoms at a surface with negative ion yields to determine the surface production rates. On present test-stands and in the proposed sources for ITER the whole plasma grid area is used as the electron suppressor by biasing it positively relative to the ion source and thus the plasma. Based on the destruction rates, only negative ions created within a few centimetres of the extraction aperture can be extracted. Therefore, only negative ions originating on the plasma grid can be extracted. The model takes into account the relative potential between the plasma and the electron suppressor in calculating the surface production rates.

.By making the assumption that the surface production rates can be directly compared with the extracted beam current then the model is compared with data where the beam current has been measured as a function of electron suppressor bias and knowledge of the plasma parameters of the source also exists. At high bias voltages relative to the plasma potential only volume produced negative ions can be extracted as negative ions created on the surface cannot cross the sheath. This allows some conclusions to be drawn regarding the relative contribution of volume and surface production of negative ions in caesiated discharges.

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