Floating sheath characteristic of a negative ion emitting electrode in electronegative plasma

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The negative ions inside the plasma volume are created either by dissociative attachment of neutrals with highly energetic plasma electrons or by impact of positive ions/hyper thermal neutrals on a low work function metallic surface. The negative ions born at the surface are accelerated across the plasma and extracted in form of a highly energetic beam. The energy and flux of emitted negative ion beam are suggestively governed by the sheath phenomena near the emitting surface. It is well known that the transport of beam negative ions across the sheath is limited by formation of a negative space charge region near the electrode. This negative space charge region is termed as virtual cathode and the emission in this case is space charge limited. These study are primarily motivated from applications such as H^- ion production in a negative ion source and in thin-film deposition using magnetron sputtering systems.

In this poster we present one dimensional model for planar sheath in front of a floating electrode surface emitting negative ions which is immersed in a collision-less, non-magnetized, electro-negative plasma. It is found that the magnitude of floating potential decreases with the increase in negative ion emission analogous to the effect of electron emitting surfaces. However the space charge effect is more pronounced in the case of negative ion emitting electrode as compared to the electron emitting electrode. It is also found that the depth of the virtual cathode with respect the plasma-sheath boundary and the transported flux of beam negative ions remains constant with increasing emission flux of negative ions. In addition to this the width of the virtual cathode increases and get saturated for higher emission flux. A Plausible explanation is given to explain these effects.

References

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