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# Modeling of magnetized three-component plasma with fluid behavior of positive and negative ions in the context of sheath formation

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For the past two decades, three component plasmas [1]–[3], i.e. plasmas comprised of positive ions, negative ions and electrons, are exceedingly adopted to reveal the imperative applications in the fields of plasma-surface interactions, semiconductor industries, thin-film deposition processes, and many more [4]–[6]. In plasma cleaning, plasma etching and plasma deposition process, plasmas with negative ions, designated as electronegative plasmas, are preferred because of relatively less potential developed on the surface of the material under investigation. The presence of negative ions avoids the irregularity in etching shapes and also enhances the material working during the fabrication process. In all such applications, the formation of a thin layer of charged species, designated as sheath [7], at the probe / material surface, when it comes into the contact with three-component plasmas, is requisite to be examined in order to reveal the realistic outcomes. Sheath characteristics are strongly influenced by the temperature of charged species, masses of the ions, collisions and external magnetic field.

In the present work, we have considered a negatively biased metallic probe immersed in a magnetized warm electronegative plasma. For this system, we adopted continuity equation and momentum transfer equation for both the positive and negative ions, whereas electrons are described by their Boltzmann distribution [8]. Poisson's equation reveals the behavior of potential surrounding a conducting metallic probe along with the use of the continuity and momentum transfer equations, with the help of proper boundary conditions. In turn, it gives rise to the information about the density profile of charged species and most importantly the thickness of the sheath. By keeping in mind, the well-known Bohm-Sheath criterion, all calculations are done.

The findings of this work shall play an imperative role to conduct the experiments in more efficient way related to the plasma processing and plasma diagnostics. Also, results would be beneficial in industrial applications where the presence of both positive and negative ions, is required.

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