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Plasma-Wall Interaction with Strong Electron Emission Revisited[1]

MICHAEL CAMPANELL, Lawrence Livermore National Laboratory

Half a century ago, Hobbs and Wesson derived a solution for the plasma sheath at a planar surface with emission coefficient γ [1]. They predicted that the floating sheath potential remains negative when $\gamma > 1$. Variations of their "space-charge limited" (SCL) sheath model have long been used to estimate the particle and energy fluxes at strongly emitting surfaces [2]. Recent theory, simulation and experimental studies show that another plasma-wall equilibrium is possible when $\gamma > 1$. In the "inverse regime" [3], the sheath potential is positive, repelling ions from the wall. The quasineutral density gradient and force balance in the "inverted presheath" are much different from the Bohm presheaths contained in the SCL models. It turns out that a SCL plasma-wall equilibrium is only stable under the assumption of zero ionization inside the sheath. Otherwise, the cumulative trapping of new ions in the SCL's potential "dip" will force a transition to the inverse regime [4]. It follows that only an inverse equilibrium should be possible in practice at floating surfaces with strong secondary, thermionic or photoelectron emissions. Applications will be discussed. [1] G. D. Hobbs and J. A. Wesson, Plasma Phys. **9**, 85 (1967) [2] (review) S. Robertson, Plasma Phys. Control. Fusion **55**, 093001 (2013) [3] M. D. Campanell, Phys. Plasmas **22**, 040702 (2015) [4] M. D. Campanell and M. V. Umansky, Phys. Rev. Lett. **116**, 085003 (2016)

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