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1P05 - Investigation of Electron Emission using Molecular Dynamics Simulations

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Continued miniaturization of electronic devices requires a comprehensive understanding of electron emission behavior at micro- and nanoscales for applications involving micro- and nanoelectromechanical systems (MEMS and NEMS, respectively) and microplasmas. While Paschen's law (PL) traditionally governs gas breakdown, field emission (FE) causes experimental deviation from PL at microscale [1]. Further reducing gap distance makes electron emission space-charge limited as defined by Mott-Gurney with collisions and Child-Langmuir (CL) at vacuum [2]. While previous work has unified PL with FE [1] and FE, MG and CL [2], more detailed simulations showing ion interactions are necessary to develop a comprehensive theory. This presentation applies molecular dynamics (MD) simulations to assess FE [3,4] with ionization and collisions and determine its impact on microscale breakdown. Understanding and quantifying the interplay and transitions amongst these emission regimes is vital for optimizing device design and ensuring reliable results.

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