

**CHILD-LANGMUIR LAW FOR SPACE CHARGE  
LIMITED CURRENT FROM A SINGLE SHARP FIELD  
EMITTER\***

S. Sun and L. K. Ang

*School of Electrical and Electronic Engineering, Nanyang  
Technological University, Singapore 639798*

This paper presents a non-uniform two-dimensional model or protrusive Child-Langmuir (CL) law for high current intense electron density emitted from a sharp metallic tip. In the model, we have used two different geometrical profiles, which are Lorentzian and prolate spheroidal shape. For a given type of emitter, the protrusive CL law is determined numerically at a fixed gap spacing and applied voltage. It is found that there is a critical applied electric field that space charge effects can not be ignored. In terms of the 1D classical CL law (planar emitter), the normalized protrusive CL law increases with the sharpness of the tip, and it reaches a saturated value, which is about 20 to 70, independent of the work function of the emitter. Comparison with prior 2D or 3D CL law for flat electrode will be discussed.

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