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Theory of Space Charge Limited Current in Fractional Dimensional Space MUHAMMAD ZUBAIR, L.K. ANG, Engineering Product Development, Singapore University of Technology and Design, East Coast Campus, 8 Somapah Road, Singapore 487372, Singapore — The concept of fractional dimensional space has been effectively applied in many areas of physics to describe the fractional effects on the physical systems. We will present some recent developments of space charge limited (SCL) current in free space and solid in the framework of fractional dimensional space which may account for the effect of imperfectness or roughness of the electrode surface. For SCL current in free space, the governing law is known as the Child-Langmuir (CL) law. Its analogy in a trap-free solid (or dielectric) is known as Mott-Gurney (MG) law. This work extends the one-dimensional CL Law and MG Law for the case of a D-dimensional fractional space with $0 < D \leq 1$; where parameter D defines the degree of roughness of the electrode surface. Such a fractional dimensional space generalization of SCL current theory can be used to characterize the charge injection by the imperfectness or roughness of the surface in applications related to high current cathode (CL law), and organic electronics (MG law). In terms of operating regime, the model has included the quantum effects when the spacing between the electrodes is small.

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