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Diffusion in Transient Space-Charge-Limited Currents*

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The recent analysis by Batra, Schechtman, and Seki neglects charge-carrier diffusion in transient space-charge-limited currents (SCLC) in photoconductor-dielectric structures. It is pointed out that such an analysis cannot predict the initial diffusion-dominated current observed by high-resolution experimental measurements. Recent work which develops the necessary mathematical theory for determining transient SCLC with diffusion is cited.

The preliminary theory for time-dependent space-charge-limited currents (SCLC) with charge-carrier diffusion *neglected* was presented by Many and Rakavy[1] and has been applied recently to photoconductor-dielectric structures by Batra, Schechtman, and Seki.[2] A more complete theory of transient SCLC with charge-carrier diffusion *included* has been developed by the present author.[3] It was shown in the latter work that diffusion effects dominate the current density during the initial stage of transient SCLC with an $E=0$ boundary condition and cannot be neglected if one desires to predict or interpret high-resolution experimental measurements[4] in a quantitative fashion. Since an $E=0$ boundary condition is featured at the photoconductor-dielectric interface (where the drift-current density vanishes and the diffusion-current density regulates the local charge-carrier flow) in the model considered by Batra, Schechtman, and Seki, diffusion effects must be taken into account in solving for the transient SCLC in photoconductor-dielectric structures that feature a characteristic diffusion time[3] $t_1 \equiv 4DL^2/\mu^2V^2$ which is large compared to the rise time of the light pulse. Such would ordinarily be the case for the photoconductor-dielectrics at field strengths V/L less than about 100 V/cm. The mathematical theory needed for solving the photoconductor-dielectric and other related transient-diffusion SCLC problems has been advanced recently in a detailed and comprehensive work by Eckstut.[5]

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