J Material Sci Eng 2018, Volume 7
DOI: 10.4172/2169-0022-C9-117

Ultrafast imaging of charge carrier dynamics on semiconductor surfaces

Ebrahim Najafi
Chemours Company, Canada

The spatiotemporal dynamics of nonequilibrium carriers reveal the excitation and relaxation pathways in materials. Here we report the ultrafast imaging of photoexcited carriers generated on the silicon surface by a femtosecond laser pulse. We use the scanning ultrafast electron microscopy (SUEM) technique to investigate the evolution of these carriers in space and time as the semiconductor proceeds to the ground state. We find that carrier transport after optical excitation follows the super-diffusion model with the diffusion coefficient that linearly increases with the laser fluence. However, this trend reverses at high excitation fluences. We attribute this anomaly to the generation of a large electric field by the spatial separation of photoexcited carriers, which strongly opposes carrier super-diffusion. This is evident in the second moment of the carrier distribution, obtained from the SUEM images, which reveals expansions and contractions in the carrier density. The numerical simulation of the drift-diffusion equation supports this interpretation. Our finding shines a new light on the dynamics of hot carriers in highly perturbed semiconductors by directly imaging their progression toward the ground state.

eb.najafi@gmail.com