Quantitative description of light-excited scanning tunneling spectroscopy — •Michael Schnedler, Verena Portz, Phillip Weidlich, Rafal Dunin-Borkowski, and Philipp Ebert — Peter Grünberg Institut, Forschungszentrum Jülich GmbH, 52425 Jülich, Germany

The efficiency of solar cell and optoelectronic devices is closely connected to the nanoscale distribution of charge carriers. In order to understand the physical processes involved at the atomic scale, the materials need to be investigated simultaneously under illumination and with atomic resolution. Photo-excited scanning tunneling spectroscopy (STS) is ideally suited to probe the illumination-induced local surface photo-voltage, band bending, carrier concentration, and the electrostatic potential distribution with atomic resolution. For a quantitative analysis, particularly of the local charge carrier concentration, a fundamental physical understanding of the photo-excited tunneling spectra is needed. We will present a new theoretical model of photo-excited STS that incorporates a fully three dimensional solver for both, the electric field and the (intrinsic and photo-excited) carrier concentrations near the semiconductor’s surface. In order to take into account both, the tip induced band-bending and the photo-excited carrier concentration, we present a modification of the tunnel current model of Feenstra and Stroscio by introducing Quasi-Fermi levels.