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Kelvin probe force microscopy: imaging open-circuit voltage in optoelectronic devices ELIZABETH TENNYSON, Materials Science and Engineering, Univ. of Maryland, JOSEPH GARRETT, Physics, Univ. of Maryland, JESSE FRANTZ, JASON MYERS, U.S. Naval Research Laboratory, ROBEL BEKELE, University Research Foundation , JASBINDER SANGHERA, U.S. Naval Research Laboratory , JEREMY MUNDAY, Electrical and Computer Engineering, Univ. of Maryland, MARINA LEITE, Materials Science and Engineering, Univ. of Maryland — Scanning probe microscopy has been successfully implemented to probe the electrical characteristics of optoelectronic devices. Currently, a method that directly correlates measured signals to device performance is missing. We implement illuminated Kelvin probe force microscopy (KPFM) to spatially resolve the open-circuit voltage of optoelectronics with nanoscale resolution, 5 orders of magnitude better than previous methods. In illuminated-KPFM, the surface photovoltage, is the difference between the contact potential difference under illumination and in the dark, and proportional to the Fermi level splitting. We apply our imaging method to a variety of solar cells and find that the open-circuit voltage in some materials varies locally by >0.2 V, suggesting the spatial variation of non-radiative recombination strongly affects performance. A detailed examination of possible topography pick-up was excluded by measuring samples with modified surface morphology and considering the tip-sample separation dependence of the signal. This novel metrology enables new insights into the loss mechanisms that hinder solar cells and provides a new platform to image device performance with nanoscale resolution.

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