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Nanoscale Imaging of Band Gap and Defects in Polycrystalline CdTe Photovoltaic Devices NIKOLAI ZHITENEV, CNST, NIST, YOHAN YOON, JUNGSEOK CHAE, AARON KATZENMEYER, HEAYOUNG YOON, SANGMIN AN, U. Maryland / CNST, JOSHUA SHUMACHER, ANDREA CENTRONE, CNST, NIST — To further increase the power efficiency of polycrystalline thin film photovoltaic (PV) technology, a detailed understanding of microstructural properties of the devices is required. In this work, we investigate the microstructure of CdTe PV devices using two optical spectroscopies. Sub-micron thickness lamella samples were cut out from a PV device, either in cross-section or in-plane, by focused ion beam. The first technique is the photothermal induced resonance (PTIR) used to obtain absorption spectra over a broad range of wavelengths. In PTIR, a wavelength tunable pulsed laser is combined with an atomic force microscope to detect the local thermal expansion of lamella CdTe sample induced by light absorption. The second technique based on a near-field scanning optical microscope maps the local absorption at fixed near-IR wavelengths with energies at or below CdTe band-gap energy. The variation of the band gap throughout the CdTe absorber determined from PTIR spectra is ≈ 20 meV. Both techniques detect strong spatial variation of shallow defects over different grains. The spatial distribution of mid-gap defects appears to be more uniform. The resolution, the sensitivity and the applicability of these two approaches are compared.

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