I present back contact geometry chalcogenide photovoltaics that place the CdTe absorber layer at the front of the device to create an analog of silicon back contact devices. I detail fabrication of the three-dimensionally structured devices starting with two interdigitated comb electrodes, followed by selective electrodeposition of n-type semiconductor on one electrode then deposition of p-type absorber over the entire device. A single patterning process thus permits differentiation of the two interdigitated combs into positive and negative electrodes in the electrodes-first, semiconductors-last process. Placement of the n-type semiconductor behind the CdTe absorber permits devices with n-type CdSe (Fig. 1) as well as the standard CdS.

Short circuit current density ($J_{sc}$) in current vs voltage measurements under simulated AM1.5 illumination are interpreted through modeling of carrier transport and recombination. With electrodeposited CdSe and pulsed laser deposited CdTe, $J_{sc}$ exceeds 15 mA/cm$^2$ and efficiency 4% for electrode comb pitch of 2 to 3 µm without antireflection coating or backcontact field at the metal/CdTe contact; surface passivation increases $V_{oc}$ by ~150 mV.

Laser beam induced current measurements with submicrometer spatial resolution are detailed and used to understand device performance. Results are also compared to quantitative modeling, the model predictions capturing trends observed with variation of electrode comb dimensions as well as semiconductor type and quality.

Device performance exceeds the performance of CdS/CdTe pillar devices with far finer dimensions.