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CZTS (Cu_2ZnSnS_4) is a promising material for solar cell absorbers and consists of abundant, environmentally friendly elements with a recently obtained efficiency of 9.4 %.
For films produced with pulsed laser deposition (PLD) from a quarternary sintered, multi-element target, the composition can deviate significantly from that of the target, depending on the laser fluence. By tuning the laser fluence from a 248-nm excimer laser beam on a sintered CZTS target (2CuS:ZnS:SnS), the metal ratios in the film can be controlled. Films were deposited in high vacuum on a Mo-coated soda lime glass substrate at room temperature. At low fluence below 1 J/cm^2 the copper content in the film is low, while at high fluence the films become copper-rich. At a fluence 0.7 J/cm^2 we have achieved a ratio Cu/(Sn+Zn) ~ 0.85 which is in the right regime for a cell.
After sulfurization and the final deposition of the buffer and window layers the best cell with an effective area of 21 mm^2 and only a 400-nm thick CZTS layer had an efficiency of 5.2 % (and V_{oc} = 616 mV, a J_{sc} = 17.6 mA/cm^2 and a fill factor of 48 %). This efficiency is the highest one obtained with an absorber layer of CZTS made by PLD until now. Despite the thin absorber, there are no signs that material and junction quality are significantly lower than that of thicker absorbers: grain size, carrier lifetimes, collection efficiency, shunt resistance, and dark saturation current are all similar to (thicker) benchmark CZTS cells.