Hole-Selective Electron-Blocking Copper Oxide Contact for Silicon Solar Cells (PV-3)

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Scientific Achievement:

A Cu_2O/Si heterojunction fabricated at room temperature using a facile sputtering process was demonstrated to work as a hole-selective contact for silicon solar cells. Passivating the Cu_2O/Si interface leads to an open-circuit voltage (V_{oc}) of 528 mV, which is 200 mV higher than the state-of-the-art.

Significance and Impact:

Metal-oxide/silicon carrier-selective heterojunctions are attractive because oxides are stable, non-toxic, and can be deposited at low temperatures at potentially low cost. Defects at the oxide/Si interface have been known to be the factor limiting the efficiency of heterojunction silicon solar cells. This work demonstrates a Cu_2O/Si hole-selective contact that shows one of the highest-reported values of V_{oc} among cells without back-surface passivation.

Research Details:

- Cu_2O was deposited using reactive sputtering at room temperature.
- X-ray and ultraviolet (UV) photoelectron spectroscopy and UV-Visible spectroscopy were used to confirm the band-alignment between Cu_2O and Si that matches for a hole-selective contact.
- The Cu_2O/Si interface as deposited was found to have more than $10^{12}/cm^2$ defects, which were passivated using a tunneling SiO_2 layer. This led to a V_{oc} of 528 mV, which is 200 mV higher than unpassivated devices.

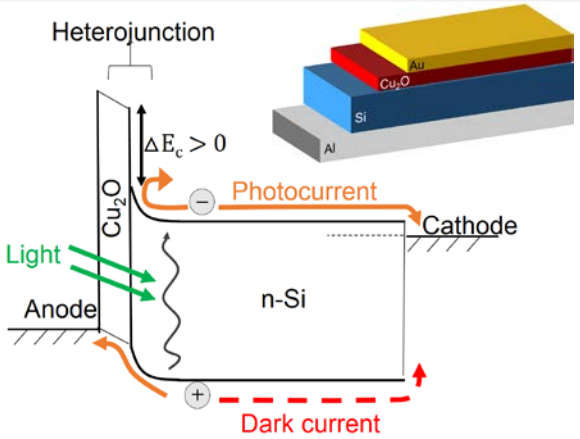

Fig. 1: Device structure and energy band diagram for a hole-selective contact.

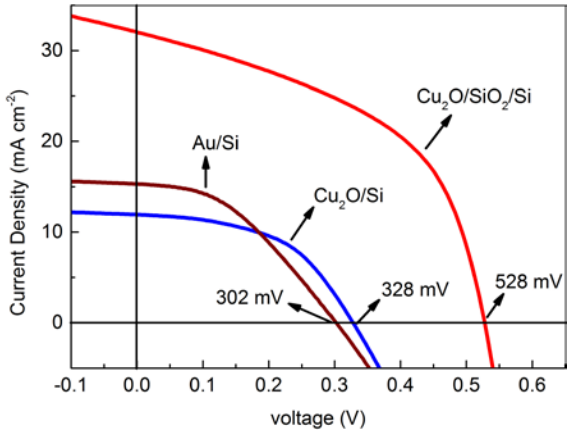

Fig. 2: Current-Voltage plot under A.M. 1.5 illumination.

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