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

Scientific Achievement:
A Cu₂O/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 Cu₂O/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 Cu₂O/Si hole-selective contact that shows one of the highest-reported values of V_{oc} among cells without back-surface passivation.

Research Details:
• Cu₂O 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 Cu₂O and Si that matches for a hole-selective contact.
• The Cu₂O/Si interface as deposited was found to have more than 10^{12}/cm² defects, which were passivated using a tunneling SiO₂ layer. This led to a V_{oc} of 528 mV, which is 200 mV higher than unpассивated devices.


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