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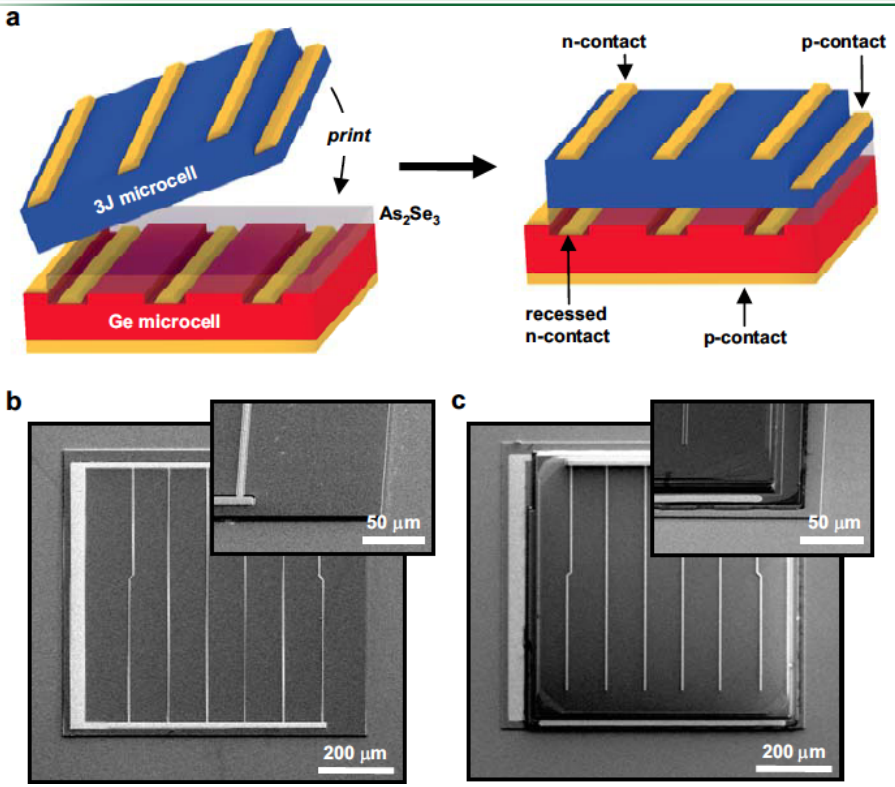
Research
Highlight

Mechanically Stacked Quadruple-Junction Microscale Solar Cells for High Efficiency Modules



Schematic illustrations and images of quadruple junction, four-terminal microscale solar cells assembled using a printing-based method and an As_2Se_3 interface material.

Work was performed at UIUC

Scientific Achievement

We demonstrate printing-based assembly of quadruple junction (4J), four terminal solar cells with measured efficiencies of 43.9% at concentrations exceeding 1000 suns, and modules with efficiencies of 36.5%. The microscale 3J/Ge cell structure utilizes an As_2Se_3-based interface layer to achieve improved light coupling between subcells with increased lower subcell photocurrent and efficiency.

Significance and Impact

Printing-based assembly of epitaxially released, multijunction (MJ) thin films with optimized interface materials enables ultrahigh efficiency module-level photovoltaics. This method offers significant advantages over conventional MJ solar cells that require epitaxial growth and current matching between individual single junctions.

Research Details

Our fabrication approach uses materials and techniques compatible with large-scale manufacturing. The strategy involves (1) printing-based stacking of microscale solar cells, (2) sol-gel process of interlayers with advanced optical, electrical and thermal properties and (3) packaging techniques, electrical matching networks, and compact ultrahigh concentration optics.

X. Sheng, C. Bower, S. Bonafede, J. Wilson, B. Fisher, M. Meitl, H. Yuen, S. Wang, L. Shen, A. Banks, C. Corcoran, R. Nuzzo, S. Burroughs, and J. Rogers, "Printing-Based Assembly of Quadruple-Junction Four-Terminal Microscale Solar Cells for the Realization of High-Efficiency Modules." Nature Materials, in press (2014).

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