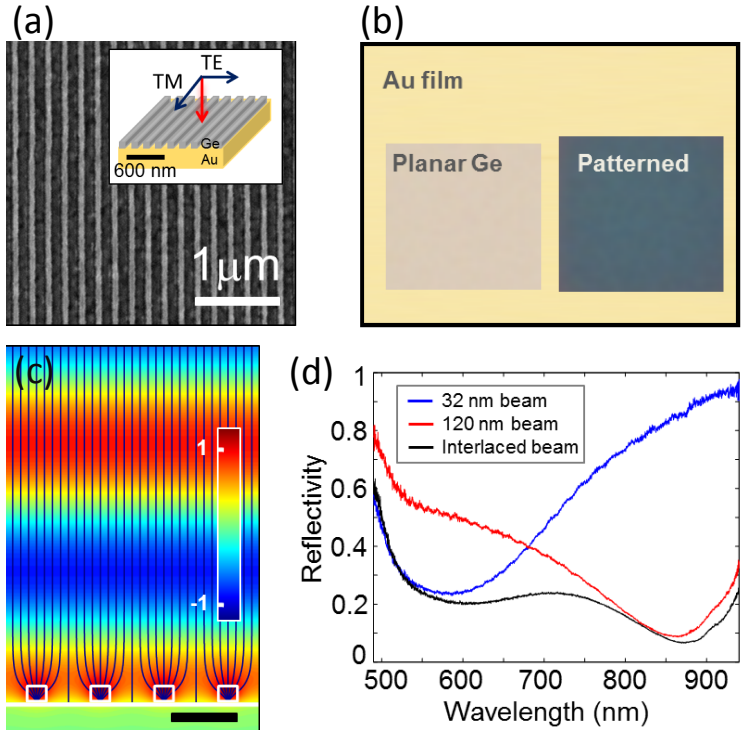
# Engineering Light Absorption in Semiconductor Metafilms

*Optical absorption by patterned Ge film*




***a)*** *Schematic and SEM image of a patterned 50-nm-thick Ge film on Au.* ***b)*** *Optical image of planar and patterned, black Ge film.* ***c)*** *Powerflow of light into Ge nanobeams on Au film, showing the effective light concentration into the beams* ***d)*** *Light absorption by a sample with 32-nm-wide Ge beams only (blue curve), by a sample with 120-nm-wide Ge beam only, and by a sample with both beams.*

Work was performed at Stanford University

## Scientific Achievement

The optical properties of semiconductors are typically considered intrinsic and fixed. We leverage the rapid developments in optical metamaterials and semiconductor antennas to create ultrathin metafilms (< 50 nm thick) with designer absorption spectra.

## Significance and Impact

The ability to create semiconductor metafilms with custom absorption spectra opens up new design strategies for ultrathin and high efficiency solar cells.

## Research Details

- Ge nanobeams can collect light from an area that is large compared to their size (panel c). This occurs at a resonance frequency linked to the beam size.
- Near-unity absorption is demonstrated in a metafilm constructed from a dense array of beams.
- Incorporating multiple beam sizes into the metafilm enables near unity absorption over a broadband of wavelengths.

Soo Jin Kim, Pengyu Fan, Ju-Hyung Kang and Mark L. Brongersma, *Nature Communications* **6**, 7591 (2015). DOI: 10.1038/ncomms8591