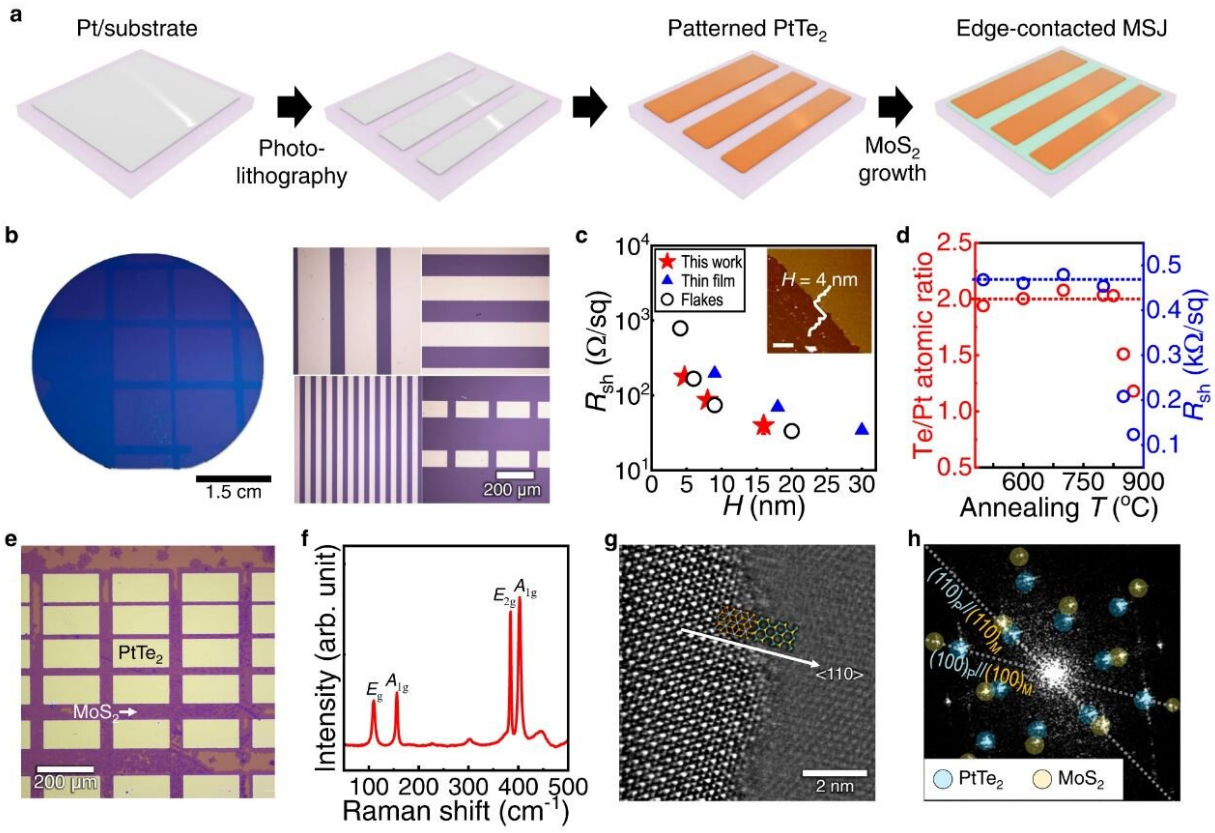
Atomic transistors based on seamless lateral metal-semiconductor junctions with sub-1-nm transfer length

November 23 2022



Wafer-scale growth of PtTe2 patterns for synthetic edge contact arrays. Credit: UNIST

A recent study, affiliated with South Korea's Ulsan National Institute of Science and Technology (UNIST) has reported a scalable synthetic strategy to fabricate low-resistance edge contacts to atomic transistors using a thermally stable 2D metal, namely $PtTe_2$.

Developing cheaper, smaller, and better-performing semiconductors with materials other than silicon (Si), is expected to gain momentum, thanks to a recent study from UNIST. This will aid in reducing the space between semiconductors and metals within semiconductor devices to ~1 nm, which could help maintain high performance.

Published in the August 2022 issue of *Nature Communications*, this study has been jointly led by Professor Soon-Yong Kwon and Professor Zonghoon Lee in the Department of Materials Science and Engineering at UNIST.

In this study, the research team reported a scalable synthetic strategy to fabricate low-resistance edge contacts to atomic transistors using a thermally stable 2D metal, namely $PtTe_2$. According to the research team, the use of PtTes as an epitaxial template enables the lateral growth of monolayer MoS_2 to achieve a $PtTe_2$-MoS_2 MSJ with the thinnest possible, seamless atomic interface.

"Our work on the synthesized edge-contact MSJ arrays offers benefits in terms of scalability for both material synthesis and device fabrication," noted the research team.

The study findings also revealed that the synthesized lateral heterojunction enables the reduced dimensions of Schottky barriers and enhanced carrier injection compared to counterparts composed of a vertical 3D metal contact.

Furthermore, the facile position-selected growth of $PtTe_2$-MoS_2 MSJ

arrays using conventional lithography can facilitate the design of device layouts with high processability, while providing low contact resistivity and ultrashort transfer length on wafer scales, noted the research team.

More information: Seunguk Song et al, Atomic transistors based on seamless lateral metal-semiconductor junctions with a sub-1-nm transfer length, *Nature Communications* (2022). DOI: 10.1038/s41467-022-32582-9

Provided by Ulsan National Institute of Science and Technology