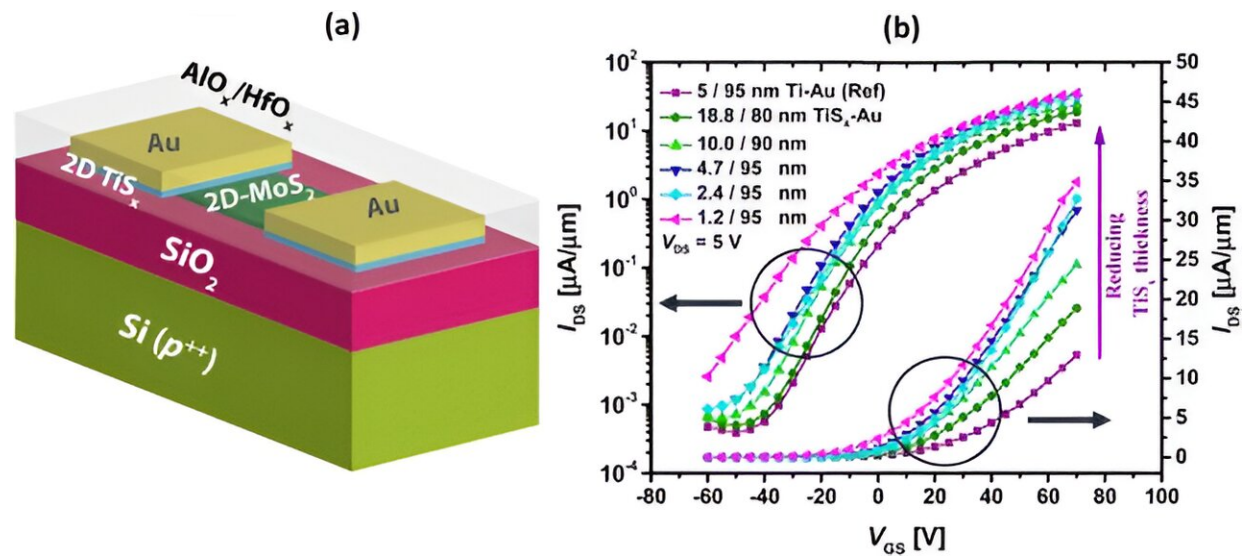


# Researchers improve the performance of semiconductors using novel 2D metal

August 18 2023



(a) Schematics of the fabricated MoS<sub>2</sub> FETs, (b) measured transfer curves of the devices with series of TiS<sub>x</sub> contact thicknesses, in both semilog and linear scales. Data for the reference sample is also provided. Credit: *Nanoscale Advances* (2023). DOI: 10.1039/D3NA00387F

Two-dimensional transition-metal dichalcogenides (2D TMDs), especially MoS<sub>2</sub>, are at the forefront of new-generation 2D materials, and industrial-level efforts are being made to produce them at a large scale with reasonable performance for electronic device applications. Usually, for display applications, charge carrier mobility of 2 cm<sup>2</sup>/V.s is sufficient.

Though mechanically exfoliated MoS<sub>2</sub> is well-known to have much higher mobility than this, its large-area production is challenging. Further, it is unclear how the performance of 2D TMD devices will be if they are contacted by [new generation](#) 2D metals instead of standard 3D metals such as Au, Ti, Ni, etc.

Hence, researchers at Eindhoven University of Technology (Tue), The Netherlands and SRM Institute of Science and Technology (SRMIST), India, have reported recently in *Nanoscale Advances* on the large-area growth of 2D metal TiS<sub>x</sub> on top of 2D semiconductor MoS<sub>2</sub> by plasma-enhanced atomic layer growth (PEALD) technique.

It's very challenging to optimize the growth conditions to obtain an atomically clean interface between such materials. Researchers found that the transistor performance of MoS<sub>2</sub> is almost two times better when contacted with the 2D metal TiS<sub>x</sub> compared to Ti and Au 3D metals. The trend was observed in most of the figures-of-merit of the transistor. This procedure can be utilized for many such materials in the future.

The charge transport study at various temperatures revealed variations in the meta-semiconductor junction barrier height and its impact on [contact resistance](#). To understand this new system, researchers performed TCAD device simulation to visualize the distribution of charge carriers in atomic layers. It is noticed that in the presence of TiS<sub>x</sub>, the intrinsic charge carrier density of MoS<sub>2</sub> increases, which leads to improved performance.

These results will allow the metallic contacts in 2D and 3D device integration to be thinned down, increasing device density. This exemplary research will play an important role in future quantum devices and in identifying new charge transport equations across the interface of 2D [metal](#)-semiconductors.

**More information:** Reyhaneh Mahlouji et al, ALD-grown two-dimensional TiS<sub>x</sub> metal contacts for MoS<sub>2</sub> field-effect transistors, *Nanoscale Advances* (2023). [DOI: 10.1039/D3NA00387F](https://doi.org/10.1039/D3NA00387F)

Provided by SRM Institute of Science and Technology

Citation: Researchers improve the performance of semiconductors using novel 2D metal (2023, August 18) retrieved 21 May 2024 from <https://phys.org/news/2023-08-semiconductors-2d-metal.html>

<p>This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.</p>
--