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Topological Weyl Semimetals as Contact for Advanced Low-Power CMOS Technology

Complementary metal-oxide-semiconductor (CMOS) is critical semiconductor technology that utilizes both n-type and p-type field-effect transistors (FETs). Two-dimensional FETs (2D-FETs), including the transition metal dichalcogenide (TMD) family, are promising candidates for developing next-generation CMOS technology that is smaller and more efficient. While high-performance, scalable n-type 2D FETs with sufficiently large drive current exist, p-type 2D FETs still suffer from high contact resistance, limiting their practical application. A Stanford team has demonstrated a breakthrough solution by using topological Weyl semimetals as the contact material for 2D p-FETs, addressing this critical bottleneck.

Topological Weyl semimetals, such as NbP and TaP, can be sputtered directly, enabling large-scale and low-cost fabrication. Compared to traditional p-type metal candidates like Pd, using Weyl semimetals as contacts on bilayer tungsten disulfide (2L-WS2) has shown a tenfold enhancement in p-type operation.

Stage of Development: Prototype

Applications

- **High-performance 2D p-FETs**
- **Low power CMOS technology**

Advantages

- **Large scale, low cost fabrication**
- **10x improved performance** - compared to using traditional metal option

Publications

- Hoang, Lauren et al. Enabling P-type Conduction in Bilayer WS2 with NbP Topological Semimetal Contacts. *arXiv (preprint)*. 2024.
- Hoang, Lauren et al. Enabling P-type Conduction in Bilayer 2D Semiconductors with Sputtered Topological Semimetal Contacts. *(preprint)*. 2024.
- Hoang, Lauren et al. Enabling P-type Conduction in Bilayer WS2 with NbP Topological Semimetal Contacts. *(preprint)*. 2024.

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