Theme: Electronic Material

- Sub Theme: Scalable channel material for Logic Device beyond Si

As the scaling of semiconductor devices has helped improve the performance of field-effect transistor devices, an ongoing effort has been made to integrate more circuits within the limited chip space. However, the shorter the channel length between the source and the drain, the more leakage current occurs between the electrodes, resulting in power dissipation. In the conventional silicon-based technology, when the length of the device is shortened, the scattering of charge carriers by dangling bonds on the surface becomes more severe, which adversely affects mobility.

Two-dimensional (2D) semiconductors are attracting attention to solve the problem of silicon-based semiconductor devices. In a channel made of 2D semiconductors, charge carriers are uniformly affected by gate voltage because they are confined to the atomically thin layer. Since the surface of the 2D semiconductor has no dangling bonds and few defects, the high mobility of charge carriers can be realized. In addition, the tunneling between the source and drain is limited because the characteristic scaling length is smaller than that of silicon. Nevertheless, there are still challenges in the practical use of 2D semiconductor devices. In order to be used in conventional semiconductor processes, a technology capable of growing large high-quality 2D semiconductor channels is required. An economical method for patterning 2D semiconductors is also needed. In order to freely control the electrical properties, doping of the 2D semiconductor is necessary, and the conventional ion implantation method seriously damages the material. Therefore, charge transfer doping or in-situ doping is recommended. The absence of dangling bonds significantly reduces the scattering of charge carriers, but a surface without dangling bonds makes it difficult to deposit dielectric materials. This “inert” surface also creates a vdW gap between the 2D semiconductor and the metal electrode, resulting in high contact resistance.

We are looking for a breakthrough approach to solve the problem of scalable channel materials. We are highly interested in (but not limited to) the following list of topics.

- Growth of 2D semiconductors
- 2D semiconductor contact engineering
- Dielectric deposition on 2D semiconductors
- Functionalization of 2D semiconductors

※ *The topics are not limited to the above examples and the participants are encouraged to propose the original idea.*

※ *Funding: Up to USD 150,000 per year*