Center for Artificial Low D Electronic Systems

2021 IBS-CALDES Seminar

- ✓ **Date & Time** 3:00PM, October 15 (Fri), 2021
- ✓ **Zoom ID: 867 3168 7471 / PW: gdjSN3**
- ✓ **Speaker & Title**

3:00PM~ Dr. Jun Woo Choi (KIST)

Unique magnetic properties of van der Waals magnetic materials

4:10PM~ Prof. Chul-Ho Lee (Korea Univ.)

Heterojunction Band Engineering for vdW Electronics & Optoelectronics

Organized by Prof. Jun Sung Kim (js.kim@postech.ac.kr, 054-279-2098)
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- **3:00PM~**

Unique magnetic properties of van der Waals magnetic materials

Jun Woo Choi
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The discovery of intrinsic magnetism in thin exfoliated van der Waals (vdW) magnetic materials has led to extensive investigation on its fundamental material properties and potential device applications. The layered structures, well-defined interfaces, and weak interlayer coupling of vdW magnets suggest that these are ideal material systems to study two-dimensional (2D) magnetic properties. Despite the promise* on providing unique opportunities to study 2D magnetic phenomena, there has been a lack of reports on properties unique to vdW magnets that truly distinguish them from ultrathin epitaxial magnetic films (e.g. Co, Ni, Fe), the historical material-of-choice for investigating low-dimensional magnetism.

In this work, we report a magnetic characteristic unique to vdW magnetic materials. We thereby provide very strong evidence that magnetic properties of vdW magnetic materials could be fundamentally different from conventional magnetic materials. An exchange bias effect is observed in a naturally oxidized vdW ferromagnet Fe3GeTe2, owing to the emergence of antiferromagnetic ordering in the surface oxide layer [1]. Surprisingly, the magnitude and thickness dependence of the exchange bias effect is considerably different from those expected in conventional magnetic thin films. Using macro-spin and analytical calculations based on textbook energy equations, we find that these observations are the consequence of the weak interlayer magnetic exchange interaction (Jinter) inherent to vdW magnets. Our “weak Jinter model” proposes a new exchange bias mechanism exclusive to vdW magnets, demonstrating unique magnetic energetics of these materials [1].

References

[1] H. K. Gweon et al., Nano Lett. 21, 1672-1678 (2021).

- **4:10PM~**

Heterojunction Band Engineering for vdW Electronics & Optoelectronics

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Two-dimensional (2D) semiconductors have attracted tremendous attention owing to their distinctive electrical and optical properties at an ultimate thickness limit. In addition, the ability to build artificial vdW heterostructures enables the implementation of various functional electronic and optoelectronic devices. To further ahieve high performance and novel functionality in such devices, it is highly required to modulate the energy bands at the heterointerfaces. In this talk, I will present novel approaches for energy band engineering in 2D semiconductor heterojunctions via monolithic phase transition and interfacial molecular assembly. Furthermore, their applications in high-performance 2D semiconductor devices, such as modulation-doped heterostructure transistors [1], 2D molecular diodes [2], multiple quantum wells [3], will be discussed.

[1] ***Nature Electron.*** 4, 664 (2021)
[2] ***Nat. Commun.*** 11, 1412 (2020)
[3] ***Sci. Adv.*** 7, eabd7921 (2021)