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Title of the Presentation: Emergent polarization and spontaneous photovoltaic effect at transition metal dichalcogenide/Black Phosphorus interface

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Short Biography:

Toshiya Ideue received B.S. and M.S. from the University of Tokyo. After he worked at Fujifilm Corporation, he returned to the University of Tokyo and received Ph.D. in engineering. He is now a research associate in the University of Tokyo. His research interests are the exotic quantum transport and optical properties originating from symmetry breaking.

Abstract:

Interfaces of two dimensional van der Waals crystals are unique material platforms in which we can explore the emergent physical properties and functionalities by selecting the appropriate material combinations and by designing the symmetry of the interface. Although translational symmetry is generally broken in van der Waals interfaces, characteristic nanostructures or symmetries can emerge, which strongly affect the electronic properties at the interface.

In this work, we focused on the polar symmetry in van der Waals interfaces. By combining the two dimensional crystals with different symmetries (three-fold rotational transition metal dichalcogenide and two-fold rotational black phosphorus), in-plane electronic polarization can be realized (Fig.1 A-C), which cause the spontaneous photovoltaic effect along the polar direction (Fig.1D) [1]. Behaviors of the observed spontaneous photocurrent are well explained by a quantum-mechanical shift current [2].

The present results offer a simple guideline for symmetry engineering applicable to a variety of van der Waals nanostructures and also provide the concept of electronic polarization in quasi-periodic systems without translation symmetry.

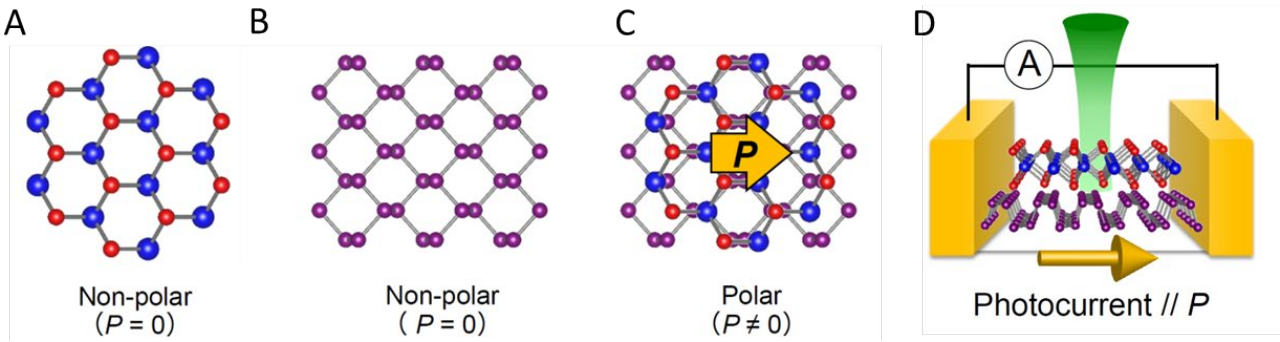

Fig. 1. Schematics of (A) transition metal dichalcogenide(TMD), (B) Black phosphorus (BP), (C) TMD/BP interface, and (D) spontaneous photovoltaic effect at TMD/BP interface.

[1] T. Akamatasu, T. Ideue *et al.*, Science **372**, 68 (2021)

[2]T. Morimoto and N. Nagaosa, Sci. Adv. **2**:e1501524 (2016)