Tunable Rashba Spin Splitting with Liquid Gated Transistors

H. T. Yuan[a], K. Morimoto[a], S. Bahramy[b], H. Shimotani[a], R. Arita[a], Ch. Kloc[c], and Y. Iwasa[a,b]

[a]*Department of Applied Physics, The University of Tokyo, Tokyo, Japan.* [b]*Correlated Electron Research Group, RIKEN, Wako, Japan.* [c]*Nanyang Technological University, Singapore.*

Manipulation of spin polarized electrons is a critical step for developing semiconductor spintronics applications. Tuning the spin-orbit interaction (SOI) and Rashba-type spin splitting by gate voltages is one of the important means for manipulating spin polarizations. However, the demonstration of gate tuning of spin polarization or SOI interactions is still limited to a few examples of mainly III-V semiconductor heterostructures. A part of the reasons is the low electric filed available in all-solid filed effect transistor (FET) devices.

In this study, we introduced a FET device with a liquid/solid interface, where extremely high electric fields over 10 MV/cm, one order of magnitude larger than those in the all-solid FETs, are available. We fabricated a liquid gates FET using a transition metal dichalcogenide semiconductor WSe_2, combined with an ionic liquid as a gate dielectric. We successfully observed the gate-tuned Rashba parameter, and found that the Rashba splitting reaches over 0.1 eV under a high electric field. The present result indicates that a liquid gating FET technique could be a useful platform for manipulating spin polarization in variety of materials.