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Tunable Zeeman-like Spin Splitting with Liquid Gated Field Effect Transistors HONGTAO YUAN, Department of Applied Physics, University of Tokyo, M.S. BAHRAMY, Correlated Electron Research Group, RIKEN, K. MORIMOTO, H. SHIMOTANI, R. ARITA, University of Tokyo, CH. KLOC, Nanyang Technological University, N. NAGAOSA, Y. IWASA, University of Tokyo — Generation of spin polarized electrons is the most critical step for developing spintronics applications. As an electric and nonmagnetic way to realize spin polarization in energy bands, spin-orbit interaction (SOI) has been widely used for spin manipulation in two-dimensional systems. For example, Rashba-type energy splitting with in-plane-polarized spins near Γ point of Brillouin zone (BZ) is able to be modulated by electric field through tuning spatial inversion asymmetry. However, Zeeman-type energy splitting with out-of-plane spin polarization is known to be sensitive only to magnetic field and supposed never to be affected by external electric field. In this paper, we theoretically uncover and experimental confirm a perpendicular-electric-field induced giant Zeeman spin splitting at low symmetric K and K' points in a layered chalcogenide, 2H-WSe_2. *Ab initio* band calculation and spin texture indicate that an electric field can make low-energy carriers spin-polarized in a out-of-plane Zeeman-type way and a tunable SOI is able to selectively control the size of splitting. A gate-induced crossover from weak localization to weak antilocalization in the magnetotransport serves as an experimental proof for the tunable SOI and spin polarization. The splitting energy deduced from quantum correction of magnetoconductance is as large as 120 meV and satisfied well with the band calculation for Zeeman-type splitting. This finding directly provides us with a new path-way for electrically initializing and manipulating electron spins for spintronics applications.

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