

# Single Crystalline CoFe/MgO Tunnel Contact on Nondegenerate Ge with a Proper Resistance-Area Product for Efficient Spin Injection and Detection

Kun-Rok Jeon, Byoung-Chul Min<sup>1</sup>, Hun-Sung Lee, Il-Jae Shin<sup>1</sup>,  
Chang-Yup Park and Sung-Chul Shin

Department of Physics and Center for Nanospinics of Spintronic Materials, Korea Advanced Institute of Science and Technology (KAIST), Daejeon 305-701, Korea

<sup>1</sup>Center for Spintronics Research, Korea Institute of Science and Technology (KIST), Seoul 136-791, Korea

We report the proper resistance-area products in the single crystalline bcc CoFe/MgO tunnel contact on nondegenerate n-Ge desirable for efficient spin injection and detection at room temperature. The electric properties of the crystalline CoFe(5 nm)/MgO(1.5,2.0,2.5 nm)/n-Ge(001) tunnel contacts have been investigated by I-V-T and C-V measurements. Interestingly, the tunnel contact with the 2-nm MgO exhibits the ohmic behavior with low resistance-area products, satisfying the theoretical conditions required for significant spin injection and detection. This result is ascribed to the presence of MgO layer between CoFe and n-Ge, enhancing the Schottky pinning parameter as well as shifting the charge neutrality level.

Key words: Nondegenerate Ge, Crystalline CoFe/MgO tunnel contact, Resistance-area product, Tunnel spin polarization, Spin diffusion length, Schottky pinning parameter, Charge neutrality level, Fermi level pinning