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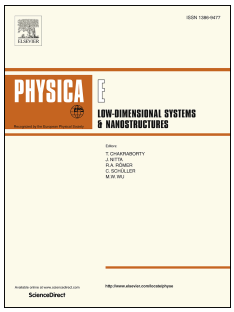

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Bui Dinh Hoi, Mohsen Yarmohammadi, Kavoos Mirabbaszadeh, Hamidreza Habibiyan

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Spin- and valley-dependent electrical conductivity of ferromagnetic group-IV 2D sheets in the topological insulator phase

Bui Dinh Hoi[a,b], M. Yarmohammadi[c,*], Kavoos Mirabbaszadeh[d], Hamidreza Habibiyan[d]

[a] *Institute of Research and Development, Duy Tan University 03 Quang Trung, Da Nang, Viet Nam*
[b] *Department of Physics, Hue University's College of Education, 34 Le Loi, Hue City, Viet Nam*
[c] *Young Researchers and Elite Club, Kermanshah Branch, Islamic Azad University, Kermanshah, Iran*
[d] *Department of Energy Engineering and Physics, Amirkabir University of Technology, Tehran, Iran*

Abstract

In this work, based on the Kubo-Greenwood formalism and the **k**.**p** Hamiltonian model, the impact of Rashba spin-orbit coupling on electronic band structure and electrical conductivity of spin-up and spin-down subbands in counterparts of graphene, including silicene, stanene, and germanene nanosheets has been studied. When Rashba coupling is considered, the effective mass of Dirac fermions decreases significantly and no significant change is caused by this coupling for the subband gaps. All these nanosheets are found to be in topological insulator quantum phase at low staggered on-site potentials due to the applied perpendicular external electric field. We point out that the electrical conductivity of germanene increases gradually with Rashab coupling, while silicene and stanene have some fluctuations due to their smaller Fermi velocity. Furthermore, some critical temperatures with the same electrical conductivity values for jumping to the higher energy levels are observed at various Rashba coupling strengths. For all structures, a broad peak appears at low temperatures in electrical conductivity curves corresponding to the large entropy of systems when

*Corresponding author
Email address: m.yarmohammadi69@gmail.com (M. Yarmohammadi)