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Spin-orbit interactions in graphene nanoribbons : Effects of the edge profile JUN-WON RHIM, KYUNGSUN MOON, Yonsei University, CONDENSED MATTER THEORY TEAM — In graphene, it has been shown by Kane and Mele that the spin orbit coupling (SOC) connects the Dirac particles to the low- lying p_x and p_y orbitals so that the quantum spin Hall effect(QSHE) arises at the edges of the graphene. Their theory has drawn considerable attention as a realization of Haldane's idea of quantum Hall effect without magnetic field and as a trigger for the surging field of topological insulator. In the work, we study the band structure of the zigzag nanoribbons with the spin-orbit interaction and argue that the role of graphene edge should be considered more carefully since the realization of the QSHE is found to be largely dependent on the edge profile such as the kinds of molecules passivated. When the edge p_x, p_y and s orbitals are dangling without any passivation, the Dirac states at the edges seem to be no longer chiral for each spin species and the QSHE is not guaranteed to occur. We notice that upon the hydrogen passivation at the edges, the spin filtered chiral edge states become available. We will explain that these are due to the interaction between π-edges states and σ-edge states. The similar calculations are also performed for the armchair nanoribbons and compared with those of zigzag nanoribbons.

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