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Quantum spin Hall effect in two-dimensional transition-metal dichalcogenide Haeckelites[1] SI-MIN NIE, ZHIDA SONG, HONGMING WENG, ZHONG FANG, Chinese Academy of Sci (CAS), T03 TEAM — The Quantum Spin Hall (QSH) effect, discovered nearly ten years ago, is such a promising option, because it can be viewed as the time-reversal-invariant version of the QH effect, which does NOT need any external magnetic field and can be in principle realized at room temperature. So far, QSH effect has only been observed in HgTe/CdTe and InAs/GaSb quantum wells. Both of them require precisely controlled MBE growth and ultralow temperature. The study of 2D TI has been seriously hampered due to lack of proper materials with large band gap, stable structure, and easy fabrication. In this report, I will introduce a family of the single layer 2D transition metal dichalcogenide (TMD) Haeckelites MX2 (M=W or Mo, X=S, Se or Te), which can host QSH effect. The phonon spectra indicate that these Haeckelites are dynamically stable. Further, a simple tight-binding model based on square-like lattice has been established to uncover the underlying mechanism. This will extend further studies from graphene-based hexagonal lattice to square-like lattice and broad the range for searching topological materials largely.

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