Evidence for room temperature quantum spin Hall state in the layered mineral jacutingaite (Pt_2HgSe_3)

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Quantum spin Hall (QSH) insulators are two-dimensional topological materials that have recently attracted tremendous interest, due to the promise of applications from low-power electronics to quantum computing. A major challenge in this field is the identification of large gap QSH materials, which would enable room temperature dissipationless transport in their edge states. Here we show that the layered mineral jacutingaite (Pt_2HgSe_3) realizes the QSH state, within the framework of the Kane-Mele model. Using ultra-high vacuum ($5 * 10^{-11}$Torr) and low temperature (9K) Scanning Tunneling Microscopy (STM), we measure a band gap of 110 meV and identify the hallmark edge states at single layer steps on top of the bulk crystal. We identify the topological nature of the gap by calculating the $\mathbb{Z}_2$ invariant, using density functional theory. By scotch tape exfoliation, we prepare thin flakes of the material and show that it can be incorporated into heterostructures of 2D materials, using well established dry stacking techniques.

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