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Ambipolar field effect in the ternary topological insulator $(Bi_xSb_{1-x})_2Te_3$ by composition tuning YULIN CHEN, DESHENG KONG, JUDY CHA, QIANFAN ZHANG, JAMES ANALYTIS, KEJI LAI, ZHONGKAI LIU, SEUNG-SAE HONG, KRISTIE KOSKI, Stanford Univeristy, SUNG-KWAN MO, ZAHID HUSSAIN, Lawrence Berkeley National Lab, IAN FISHER, ZHI-XUN SHEN, YI CUI, Stanford Univeristy, STANFORD UNIVERSITY COLLABORATION, LAWRENCE BERKELEY NATIONAL LAB COLLABORATION — Topological insulators exhibit a bulk energy gap and spin-polarized surface states that lead to unique electronic properties, with potential applications in spintronics and quantum information processing. However, transport measurements have typically been dominated by residual bulk charge carriers originating from crystal defects or environmental doping, and these mask the contribution of surface carriers to charge transport in these materials. Our recent work demonstrates that the ternary sesquichalcogenide $(Bi_xSb_{1-x})_2Te_3$ is a tunable topological insulator system. By tuning the ratio of bismuth to antimony, we are able to reduce the bulk carrier density by over two orders of magnitude, while maintaining the topological insulator properties. As a result, we observe a clear ambipolar gating effect in $(Bi_xSb_{1-x})_2Te_3$ nanoplate field-effect transistor devices, similar to that observed in graphene field-effect transistor devices. The manipulation of carrier type and density in topological insulator nanostructures demonstrated here paves the way for the implementation of topological insulators in nanoelectronics and spintronics.

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