Abstract Submitted
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**Electron beam irradiation effect on $Bi_2Se_3$ topological insulator nanodevices**[1] ZHIYONG WANG, PENG WEI, XINFEI LIU, JING SHI, Department of Physics and Astronomy, University of California Riverside — Nanofabrication is found to introduce excess charge carriers and results in a strong metallic state in $Bi_2Se_3$. The uncontrolled carrier density causes the Fermi level to rise to the conduction band. To verify the effect of the electron beam lithography (EBL), we have measured the carrier density of $Bi_2Se_3$ nanodevices before and after EBL with a range of electron beam energies and doses and find that the Fermi level rises in both n- and p-type devices. To effectively control the position of the Fermi level, we have developed a nanofabrication-free technique for $Bi_2Se_3$ nanodevices, with which the initial state of the bulk materials can be well preserved. We deliberately choose p-type Ca-doped $Bi_2Se_3$ devices and systematically introduce more electrons using successive EBI. Resistiviy temperature dependence shows that the Fermi level position is gradually tuned from the valence band into the band gap. Further fine tuning of the Fermi level is accomplished by applying a gate voltage to the devices. An increase of a factor of 10 in mobility has been observed in the device as the Fermi level is brought into the band gap, which is consistent with the suppressed backscattering of the surface states in topological insulators.

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Zhiyong Wang
Department of Physics and Astronomy, University of California Riverside

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