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Ultra-high near infra-red photoresponsivity in graphene-topological insulator hybrids

The opto-electronic properties of Van der Waal's materials and their hybrids has been a matter of intense discourse since the extraction of graphene, especially the quest for sensitive infra-red (IR) detectors at high temperatures, due to the diverse technological applications. However, since these materials and their hybrids typically do not show photo-response in the infra-red regime, significant complex device fabrication procedures are required to create infra-red sensors out of them. This can be addressed by employing bismuth-based chalcogenides, having bulk band gap of $0.1 - 0.3$ eV. But due to both high recombination rate and low mobility in these materials, the electrical response to incident photons is very low. We have addressed this by forming binary hybrids of graphene and Bi_2Te_3 nanowires. Our devices show an extremely high sensitivity of $10^5 - 10^6$ AW^{-1} in the wavelength range of 920 nm – 1720 nm till $T = 200$ K [1]. The photo-response transpires due to the transfer of hot carriers from Bi_2Te_3 to graphene. The specific detectivity of our devices is also $10^{10} - 10^{11}$Jones which is comparable to the best detectors reported so far. The noise equivalent power of these devices is 10^{18} Jones.

References

[1] Saurav Islam, Jayanta Kumar Mishra, Abinash Kumar, Dipanwita Chatterjee, N Ravishankar, and Arindam Ghosh Nanoscale, 11 (2019) 870-877