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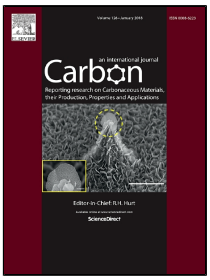

Giant optical absorption and low dark current characteristics in wrinkled single layer graphene/bismuth nanorods heterostructures

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Giant optical absorption and low dark current characteristics in wrinkled single layer graphene/bismuth nanorods heterostructures

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ABSTRACT

Wrinkled graphene shows an enhanced photoelectric effect owing to the opening of a bandgap induced by stress. Here, bismuth (Bi) nanorods array with trigonal orientation are assembly grown on silicon substrates by molecular beam epitaxy. Single layer graphene (SLG) is transferred on top of the Bi nanorods array to make flat SLG forming into wrinkles. Through the application of visible-infrared and Fourier transform infrared spectroscopies, enhanced optical absorption in the wrinkled SLG/Bi nanorod heterostructures was observed. Raman spectral analysis showed a large 2D peak shift of up to −11 cm^{-1} compared with that of flat graphene on silicon wafers. This finding indicates the existence of a tensile stress induced opening of the band gap. Nonlinear current-voltage characteristics confirmed the opening of an intrinsic bandgap in the wrinkled graphene. The on-off ratio was shown to increase by 30 times and the dark current was remarkably suppressed by 3 to 4 orders of magnitude for the Bi nanorods/wrinkled SLG heterostructures when compared with those properties of flat SLG on silicon.

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