Defect modulated photoresponse and thermal conductivity in graphene

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Abstract (Arial 10)

There is a great need for controlling the properties of two dimensional (2D) materials to fulfill the requirements of various applications.[1-4] Here, we present our results on the modulation of the properties of graphene by controllably introducing different types of defects.

Firstly, the graphene-based photodetector with tunable p-p+-p junctions has been successfully fabricated using a simple laser modification method. Distinct photoresponse was observed at the graphene (G)- laser-modified graphene (LMG) junction through scanning photocurrent measurements, and Raman spectra reveal that defects are created at the LMG region. Detailed investigation suggests that the photo-thermoelectric effect, instead of the photovoltaic effect, dominates the photocurrent generation at the G-LMG junctions.

Secondly, we adopted molecular dynamics simulations and non-contact optothermal Raman measurements to identify the correlation between the lattice defects and thermal conduction transport in graphene. We find that the thermal conductivity of graphene can be significantly reduced even at extremely low defect concentration (~83% reduction for ~1‰ defects), where defects act as localized scatters and greatly reduce the conductivity. Our findings provide fundamental insights into the physics of thermal transport in graphene, and two-dimensional materials in general, which could help on the future design of functional applications such as optothermal and electrothermal devices.

References

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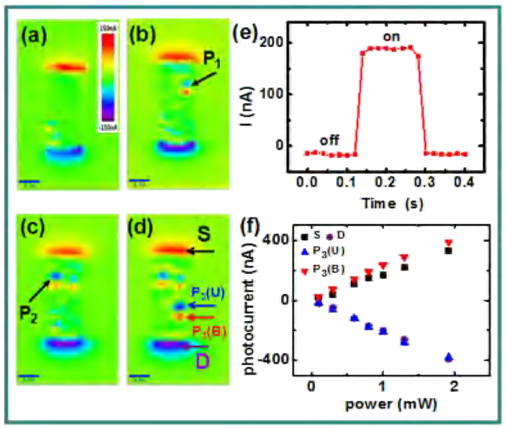
Figures



Photocurrent image of graphene before (a) and after laser modification at different positions: P1 (b), P2 (c), P3 (d), respectively. (e) Photoswitching characteristic at the bottom spot near LMG (P3) (P3(B)). (f) Photocurrents as function of the laser power detected at regions near P3 and graphene-metal contacts as marked in (d).