Second-order nonlinear transport and its modulation

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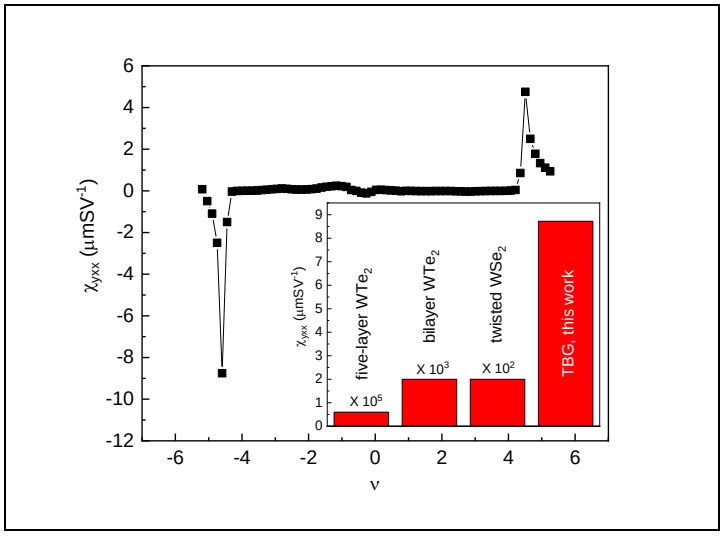
Abstract

The second-order nonlinear transport illuminates a frequency-doubling response emerging in quantum materials with broken inversion symmetry. It has been theoretically proposed to hold great potential in high-frequency rectification devices, broadband long-wavelength photodetection, and energy harvesting. However, a general understanding of the mechanisms of the nonlinear Hall effect (NLHE) is missing. Meanwhile, the lack of efficient modulation and broad material family have hindered the application of the NLHE. To solve these problems, we have studied the NLHE in twisted graphene systems and developed interface-modulation method in materials with inversion symmetry. In twisted bilayer graphene system, we have observed a giant NLHE response and clarified the contribution from impurity and phonon. In twisted double bilayer graphene system, we have observed a record high NLHE conductivity and realized the modulation of the two principal mechanisms in a single system for the first time. In addition, through Al_xO_3-assisted exfoliation, we have induced strong Berry curvature dipole and NLHE in materials with inversion symmetry, which largely expand the material family and has the advantages in massive production.



Pic.1 Giant NLHE conductivity observed in twisted bilayer graphene.

Bibliography
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