# Evidence of van Hove singularities in ordered grain boundaries of graphene

With the support by the National Natural Science Foundation of China and National Basic Research Program of China, Prof. Hou Jianguo and Prof. Wang Bing's laboratory at Hefei National Laboratory for Physical Sciences at the Microscale, University of Science and Technology of China, reported the existence of van Hove singularities in ordered grain boundaries in graphene, which was published in *Physical Review Letters* (**2014**, 112: 226802).

Grain boundary (GB) is a common topological defect in large-area polycrystalline graphene prepared by chemical vapor deposition. It is generally recognized that GB is detrimental to the electronic properties of graphene-based devices, reducing the conductivity and carrier mobility. However, theoretical calculations have predicted that the electron transport performance could be possibly enhanced by the van Hove singularity (VHS) states near the Fermi energy ($E_F$) in the ordered GBs, existing as quasi-one dimensional periodic structures in graphene.

In this research, using scanning tunneling microscopy and spectroscopy (STM/STS), the existence of VHS states in different types of ordered GBs in single-layer graphene is confirmed for the first time. By comparing the electronic behaviors of the ordered and disordered GBs in graphene, the differences between VHSs and localized defect states are analyzed, which is helpful to understand the contradictory results of transport measurements about individual GBs. Combined with theoretical calculations, the carrier concentration around ordered GBs can be significantly enhanced by VHS states. Based on the above results, the researchers propose a promising structure of a graphene nanoribbon with a properly embedded ordered GB, which can improve the performance of graphene-based electronic devices.

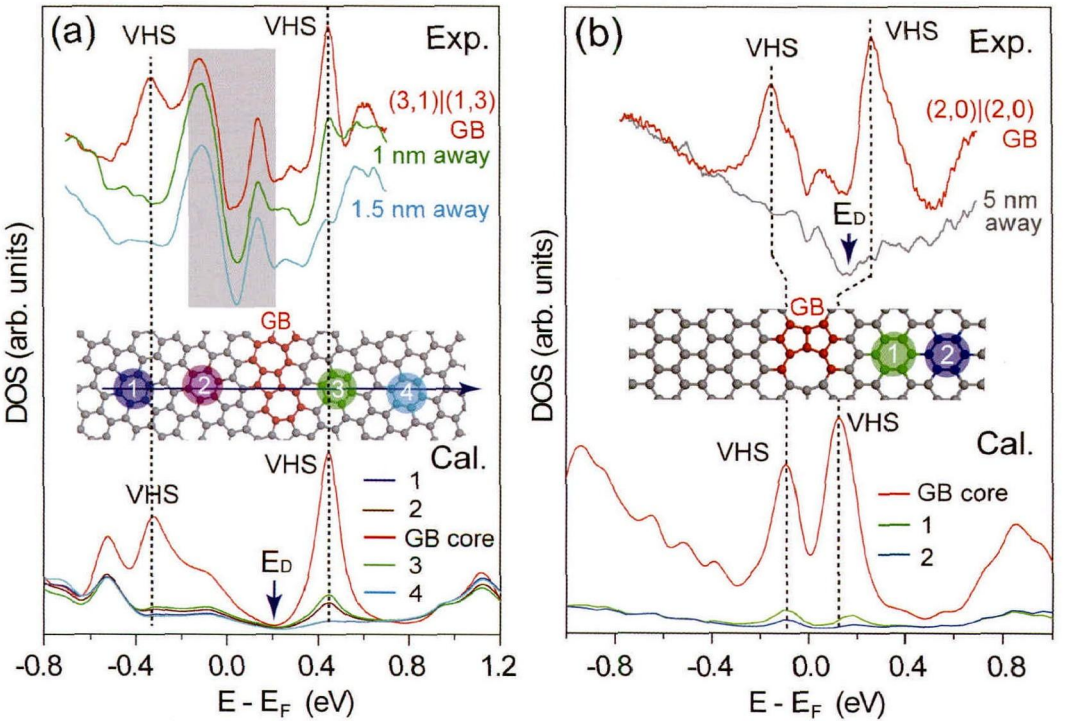


**Figure** The experimental and theoretical results of the existence of VHSs in (3,1)|(1,3) GB (a) and (2,0)|(2,0) GB (b).