Hyperdislocations in van der Waals Layered Materials

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Dislocations are one-dimensional line defects in three-dimensional crystals or periodic structures. It is common that the dislocation networks made of interactive dislocations be generated during plastic deformation. In van der Waals layered materials, the highly anisotropic nature facilitates the formation of such dislocation networks, which is critical for the friction or exfoliation behavior for these materials. By transmission electron microscopy analysis, we found the topological defects in such dislocation networks can be perfectly rationalized in the framework of traditional dislocation theory, which we applied the name "hyperdislocations". Due to the strong pinning effect of hyperdislocations, the state of exfoliation can be easily triggered by 1° twisting between two layers, which also explains the origin of disregistry and frictionlessness for all of the superlubricants that are widely used for friction reduction and wear protection.