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Electrochemical Surface Modification of Two-Dimensional Hexagonal Boron Nitride for Generating Midgap Energy States

The surface functionalization has been regarded as one of approaches to modulate the electronic structure of covalent nanomaterials such as carbon nanotube and graphene sheet. Although two dimensional hexagonal boron nitride (h-BN) has the similar chemical structure to that of graphene, the spontaneous chemical reactions for realizing the surface functionalization on h-BN were rarely reported due to its insulating electronic property. In general, single electron transfer (SET) process from nanomaterial to organic molecules is a prerequisite process for radical-based functionalization reactions, but SET from insulating material is restricted because of zero density of states near the Fermi level of insulating material. Herein, we present the new chemical route to facilitate the direct functionalization on insulator, h-BN. Aryl groups were successfully functionalized on the h-BN by the electrochemical reduction reaction of 4-BBDT. The electrochemical process can drive the electron tunneling from working electrode to 4-BBDT through h-BN film (both monolayer and multilayer) by electron tunneling process, and produce the highly reactive diazonium radical on its surface. Then, aryl radicals can be covalently functionalized on h-BN surface. In addition, this rapid reaction process can modulate the electronic structure of h-BN. We believe that our demonstration does not only provide fundamental insights for developing the surface functionalization reaction on 2D materials, but also can advance the applications of h-BN-based optoelectronic devices

References

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Figures

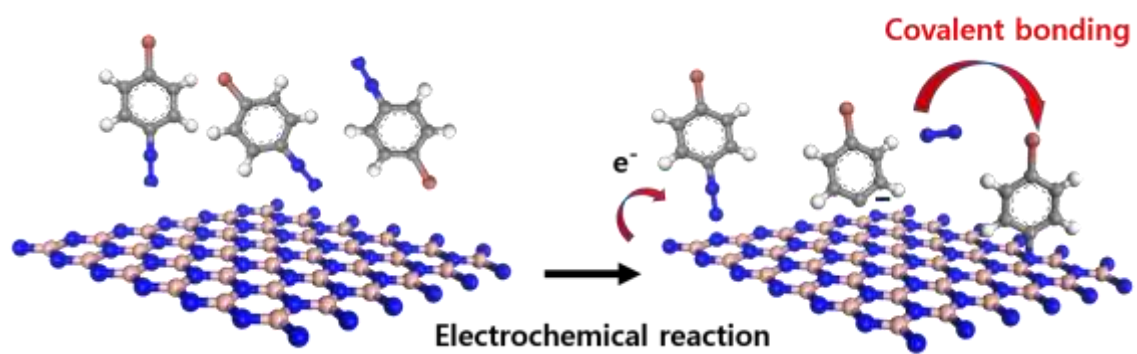


Figure 1: h-BN-4BBDT electrochemical reaction