

Boroxene: a novel 2D material

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We present the synthesis and the characterization of a novel 2D material, showing promising properties in terms of electronic transport, morphology and facile formation process. The synthesis relies on the well-established polycondensation reaction of boronic functional groups into boroxine rings (B_3O_3 hexagons) on a metallic substrate [1]. Boroxine condensation is widely adopted in surface science for the fabrication of 2D nanoporous organic frameworks, exhibiting good crystallinity and robustness [2]. These systems, however, lack of effective charge transport properties, due to the poor electronic coupling between the boroxine rings and the phenyl-backbones constituting the architectures [3]. To overcome this limit, we adopted an inorganic precursor molecule, the tetrahydroxydiboron ($H_4B_2O_4$), that reacts at room temperature on Au(111) to form a framework where the boroxine rings are directly linked, without any “spacing” group between. In our material, that we name boroxene, the boroxine rings result to be well coupled, promoting an electron delocalization, as evidenced by dispersion of electronic states in the valence band. Considering the morphology of the system, the boroxene exhibits the presence of nanopores, opening to its possible employment as a template for the growth of complex hybrid organo-metallic interfaces. These findings gain even more importance if considered that recently we have evidenced the presence of a vertical charge delocalization between boroxine rings and gold substrate in a model system [4]. Boroxene could therefore act as both electrode and charge mediator for its guest molecular species.

Tetrahydroxydiboron

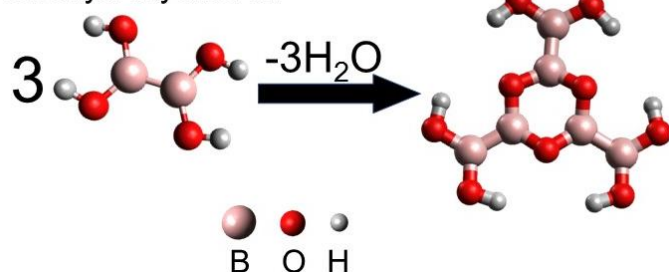


Figure 1: boroxination reaction of tetrahydroxydiboron that leads to the formation of the boroxene. We have performed this reaction on Au(111) surface under ultra high vacuum conditions.

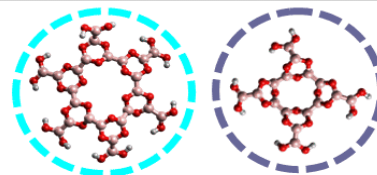
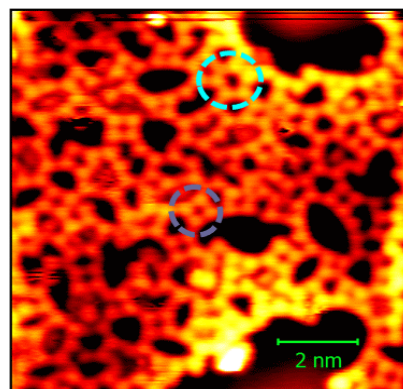


Figure 2: STM image of the boroxene with nanopores. Circled two possible condensation geometries.

References:

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