Hetero-epitaxial monolayers of graphene and hexagonal boron nitride on Ir(111)

R. Drost[1] S. K. Hämäläinen[1] F. Schulz[1] P. Liljeroth[1]
[1]Department of Applied Physics, Aalto University School of Science, Espoo, Finland

After almost a decade of intensive research, the interest in graphene is unabated. The material's many exceptional properties make it very attractive as a candidate for industrial and technological applications, while fundamental researchers are especially fascinated by the rich electronic structure of graphene[1]. Hexagonal boron nitride (h-BN), a large bandgap insulator structurally similar to graphite, has emerged as a promising support material for graphene, with with electron mobilities of graphene samples on h-BN approaching those measured in suspended graphene[2]. Furthermore, the combination of h-BN and graphene within a single layer, both in the form of domain structures as well as the use of B and N as dopants, offer routes to engineer the graphene band structure[3][4][5]. It is clear that the interface of graphene with h-BN in a hetero-epitaxial monolayer will play an important role in it's electronic properties. In order to fully understand the possibili ties offered by mixing the two materials, a detailed study of the interface region is necessary.

Both graphene and h-BN samples of high qulity can be readily grown by chemical vapour deposition (CVD) on transition metal surfaces under UHV conditions. The growth of graphene has been studied in depth especially on the Ir(111) surface, making it a good testing ground for hetero-epitaxial layers of graphene and h-BN[6][7]. We grow a single layer of hybridised graphene and h-BN domains on the Ir(111) surface in a two-step process. In a first step, small islands of graphene are formed from an ethylene precursor by temperature controlled growth. Following the deposistion of graphene, the remainder of the surface is covered in h-BN through thermal cracking of borazine ($B_3N_3H_6$) on Ir(111). Both processes are self-limiting, so that monolayer coverage is ensured. The resulting films are characterised by standard surface science techniques such as AES and LEED, followed by thorough study with a low-temperature STM with a focus on the geometric and electronic structure of th e graphene/h-BN interface.

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