

Electrochemical Transfer of Large-Area Single Crystal Epitaxial Graphene from Ir(111)

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Abstract

Transfer of large single crystal graphene is highly desired and important for applications in nanoelectronics.^[1] A promising and inexpensive approach for manufacturing high-quality graphene is chemical vapor deposition (CVD) onto transition metals. In particular, growth of strictly monatomic graphene of well-defined orientation and macroscopic extension can be achieved on metal single crystals such as Ir(111).^[2] Unfortunately, the task of transferring such high-quality graphene to other substrates is difficult, because of the strong interaction between the Ir surface and graphene.^[3]

In this work we present a new electrochemical method, which in a two-step procedure can accomplish the transfer of large-area single crystalline graphene from Ir(111) under ambient conditions. First, tetraoctylammonium ions (TOA⁺) are intercalated between the Ir(111) crystal and graphene by charging the latter. The graphene layer is supported with a drop coated polymer layer, before the second electrochemical step is applied. This step consists of electrochemical reduction of protons in aqueous solution to cause hydrogen evolution and, thereby, enabling transfer of large millimeter-sized and nearly perfect monolayer graphene from Ir to another substrate such as SiO₂/Si. This simple technique allows transfer of graphene single crystals having the same size as the substrate they are grown on (diameter \approx 7 mm). In addition, after delamination the substrate can be reused for further growth cycles and transfer of graphene. Raman mapping was used to analyze and determine the structural defects and strained wrinkles in the transferred graphene.

References

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Figures

