Non-destructive electrochemical graphene transfer from reusable thin-film catalysts

We demonstrate an electrochemical method - which we term oxidative decoupling transfer (ODT) - for transferring chemical vapor deposited graphene from physically deposited copper catalyst layers. This copper oxidation-based transfer technique is generally applicable to copper surfaces, and is particularly suitable where the copper is adhered to a substrate such as oxidized silicon. Graphene devices produced via this technique demonstrate 30% higher mobility than similar devices produced by standard catalyst etching techniques. The transferred graphene films cover more than 94% of target substrates - up to 100 mm diameter films are demonstrated here - and exhibit a low Raman D:G peak ratio and a homogenous and continuous distribution of sheet conductance mapped by THz time-domain spectroscopy. By applying a fixed potential of -0.4 V vs. an Ag/AgCl reference electrode - significantly below the threshold for hydrogen production by electrolysis of water - we avoid the formation of hydrogen bubbles at the graphene-copper interface, preventing delamination of thin sputtered catalyst layers from their supporting substrates. We demonstrate the reuse of the same growth substrate for five growth and transfer cycles and prove that this number is limited by the evaporation of Cu during growth of graphene. This technique therefore enables the repeated use of the highest crystallinity and purity substrates without undue increase in cost. (C) 2015 Elsevier Ltd. All rights reserved.

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