Raman spectral indicators of catalyst decoupling for transfer of CVD grown 2D materials

Patrick Rebsdorf Whelan[a]
Bjarke S. Jessen[a,b], Ruizhi Wang[c], Birong Luo[a], Adam C. Stoot[a], David M. A. Mackenzie[a], Philipp Braeuninger-Weimer[c], Alex Jouvray[d], Lutz Prager[e], Luca Camilli[a], Stephan Hofmann[c], Peter Bøggild[a,b], and Timothy J. Booth[a]

[a]*DTU Nanotech, Technical University of Denmark, Ørsteds Plads 345C, 2800, Denmark*
[b]*Center for Nanostructured Graphene (CNG), Technical University of Denmark, 2800, Denmark*
[c]*Department of Engineering, University of Cambridge, Cambridge, CB3 0FA, UK*
[d]*AIXTRON Ltd, Anderson Road, Buckingway Business Park, Cambridge, CB24 4FQ, UK*
[e]*Leibniz-Institut für Oberflächenmodifizierung e.V. Permoserstrasse 15, 04318 Leipzig, Germany*

patwhe@nanotech.dtu.dk

We present a systematic study of the relationship between the evolution of the Raman spectra of graphene on Cu during water oxidation and the graphene coverage obtained after transfer. We find that it is possible to measure the point at which the graphene is fully decoupled from the Cu substrate and consequently when close to 100% coverage is obtained. Changes in the Raman 2D peak characteristics

$$\Theta = \frac{I(2D^-)}{I(2D^-)+I(2D^+)}$$

give a reliable indication of the decoupling time, enabling us to transfer graphene with up to 99.7 % monolayer graphene coverage on SiO_2.
We also show that the mechanical peeling based transfer method is applicable to hexagonal boron nitride (hBN), which we transfer with coverages of >97.5 %.

We expect that Raman spectroscopy could consequently be used both for detecting the decoupling time before transfer and for post-transfer characterization.

Figures

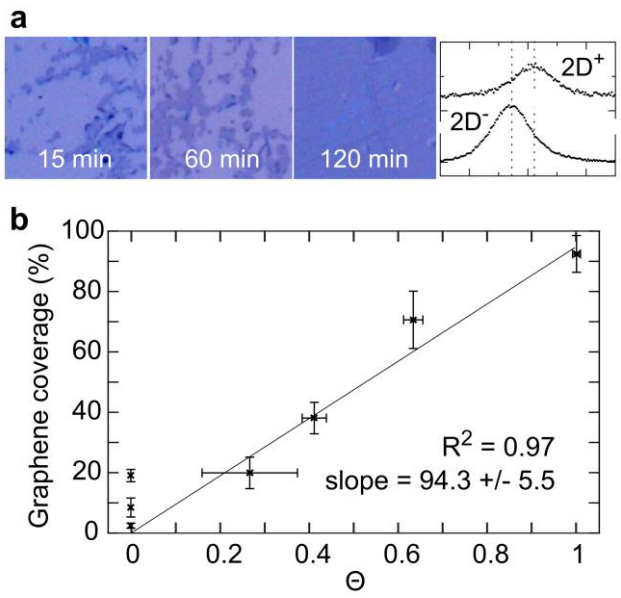

Figure 1: (a) Optical images of graphene transferred to SiO_2 after different oxidation times in DI water at 40°C together with the Raman 2D peak before (top) and after 120 min water oxidation. (b) Graphene coverage on SiO_2 after transfer as a function of Θ.

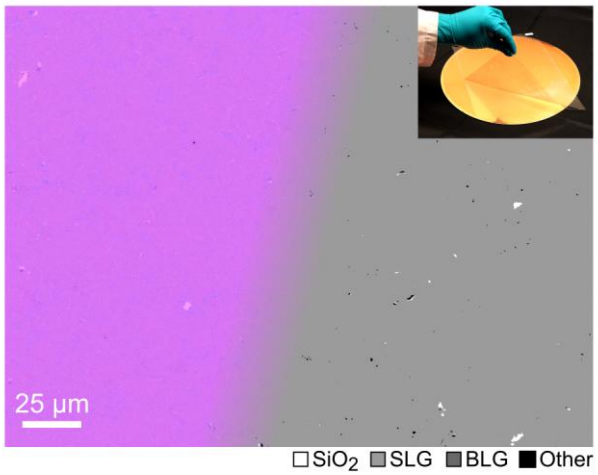

Figure 2: White light optical microscopy (left) and coverage image (right) of graphene transferred to SiO_2. Inset shows a photograph of graphene being transferred from a 12-inch wafer using PVA.