Low temperature wafer scale growth of graphene on catalytic CuNi(111)/sapphire, CuNi/SiO_2 templates using industrial CVD system

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(MO)CVD ((Metal-Organic) Chemical Vapour Deposition) is an established method for the growth and development of semiconductor materials on an industrial scale. CVD growth of high-quality graphene on various substrates has been demonstrated in many research laboratories [1,2,3,4]. The growth of graphene at low temperatures (<800°C), e.g. by applying catalytic CuNi metal templates [5], is very attractive for the resolution of the issue of graphene wrinkles formation at high growth temperatures, since wrinkles may impair the performance of the graphene-based devices like GFETs. [6]
In this contribution, we report on the low temperature growth of single layer graphene (SLG) grown on catalytic $Cu_{85}Ni_{15}$ metal templates by CVD in an AIXTRON commercial close coupled showerhead (CCS) reactor using methane CH_4 as precursor. Graphene quality on the $Cu_{85}Ni_{15}$(111)/sapphire has been optimised by varying the growth parameters: deposition temperature, growth duration, carrier gas nature (Ar, N_2). The obtained SLG films were characterised by Raman spectroscopy (Fig.1a) and AFM (Fig.1b). The coverage density of graphene films has been determined by optical microscopy after mild oxidation of the sample surface at ~100°C in air. The optimised graphene samples grown at temperature as low as 780°C in Ar demonstrated full coverage, 2D/G peak ratio ~2, absent D peak, FWHM (2D) ~35 by Raman. Graphene has been also grown on 200 mm size $Cu_{85}Ni_{15}/SiO_2$ with varying thicknesses of the CuNi layer (200, 300, 400 nm). The target was to establish a minimum viable temperature for graphene growth with a goal to reduce surface roughness to improve transferred graphene quality. Reasonable quality graphene according to Raman (2D/G ~2, nearly absent D peak, FWHM (2D) <60) has been obtained at low growth temperature (780°C). The next phase of this work will be to optimise the in situ graphene growth on CuNi/SiO_2 in line with the work on CuNi(111)/sapphire.

References

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Figures

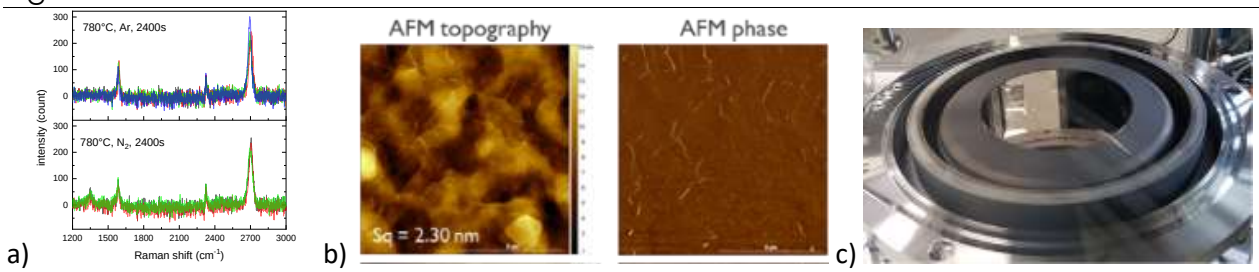

Figure 1: a) Graphene on CuNi(111)/sapphire: a) Raman; b) AFM; c) SLG on 200mm CuNi/SiO_2