CVD graphene growth on non-planar surfaces, a pilot investigation

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Abstract
Graphene has attracted a lot of attention due to its unique optical, electronic and mechanical properties, promising transparent, flexible, faster electronics as well as the possibility of making completely new kinds of devices [1, 2]. Moreover, graphene's impermeability makes it a strong candidate for new types of advanced anticorrosive coatings [3]. As the process of growing graphene on planar catalysts (e.g. Cu or Ni) is becoming well understood new challenges arise growing graphene on industrial, 3-dimensional rough non-clean samples or in processes were the catalyst shape is used for graphene band gap engineering.

One first step to overcome these challenges, and be able to grow graphene on different substrates for instance cheaper catalysts, is to investigate the effect of surface roughness of the catalyst material. Previous work has demonstrated growth of graphene on some nanostructures [4]. Here we present a pilot study investigating the roughness limits for graphene growth on nickel. Different grades of roughness were fabricated using clean room techniques and black silicon reactive ion etching [5] to create these surfaces. These substrates were covered by a nickel film and the wafers etched away to leave behind a pure nickel slab with the desired surface morphology. An Aixtron Black Magic chemical vapour deposition (CVD) system was used for the growth of graphene. Subsequently the samples were investigated using optical microscopy (OM), scanning electron microscopy (SEM) and micro Raman spectroscopy mapping [6].

Raman spectroscopy gives indications of a roughness limit for graphene growth on a nickel catalyst and thus reveals some of the challenges of making graphene a part of a viable coating solution.

References

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Figures

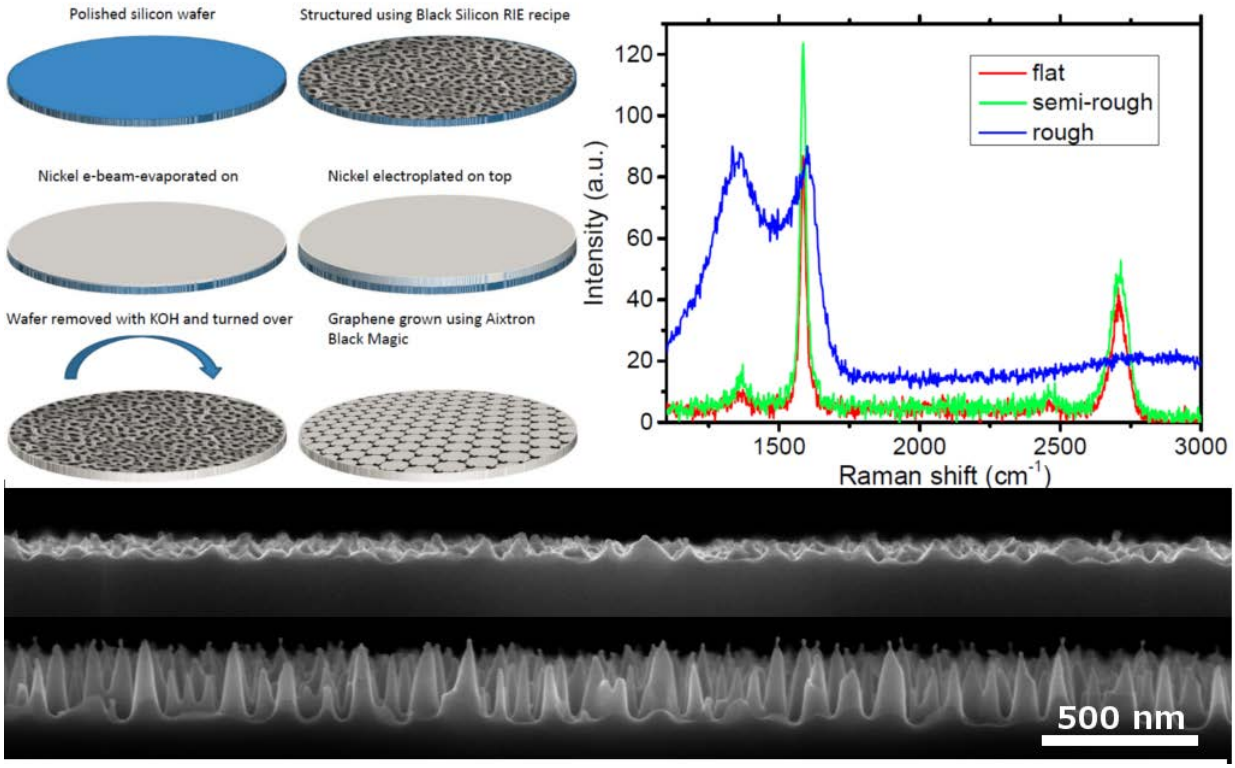

Figure 1: Clean room fabrication of the samples using black silicon RIE, e-beam evaporation of pure Ni, electroplation of further nickel, KOH etch of the sample wafer and lastly graphene growth using the Aixtron Black Magic CVD-system. In the upper right image some Raman sample spectra are shown. These show the quality of graphene grown using the same recipe on completely flat Ni, slightly roughened Ni (upper SEM image) and considerably roughened Ni (lower SEM image). It should be noted that the SEM images show the silicon structure and the Ni shape is therefore the structures reversed.