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Single Crystal Graphene growth for Graphene Liquid Cell fabrication

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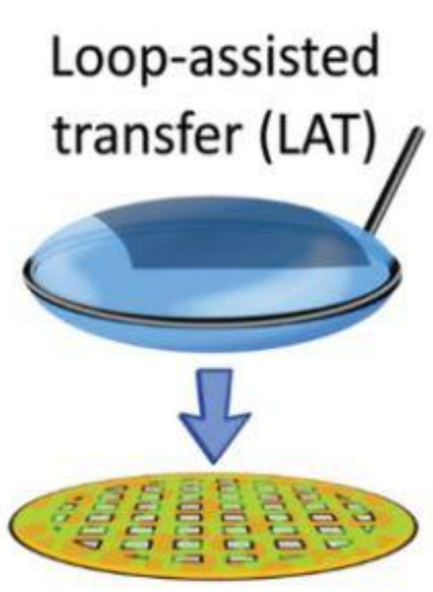
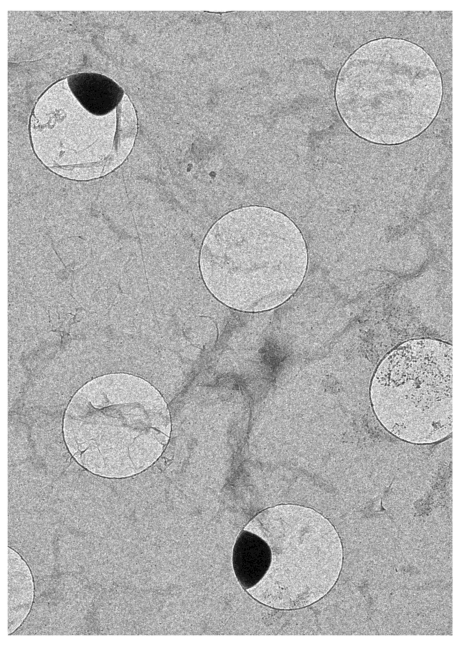
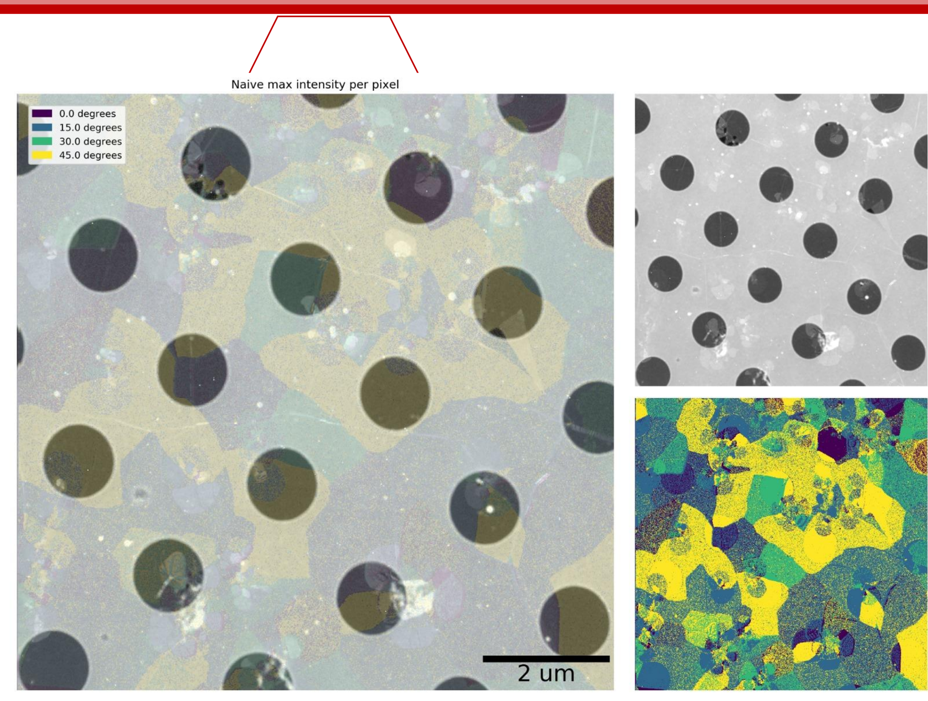
Introduction

A preferred way for GLC fabrication is LAT, because of the higher yield in visible area. LAT requires the handling of support-polymer free graphene, which is notoriously difficult. Grain boundaries and defects in graphene will render it less mechanically stable. Therefore we set out to grow our own CVD graphene with larger single crystal domains, based on procedures described in the literature.







1. Influence of temperature

We have used preoxidized copper substrates to grow graphene at different temperatures. The results we obtained are in line with what has been described in the literature: higher growth temperatures will yield larger graphene crystals.

3 min preox | 10 min preox

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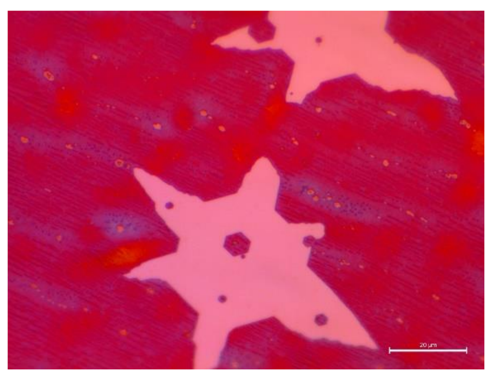

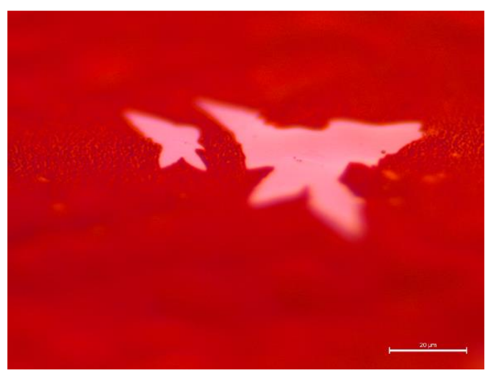

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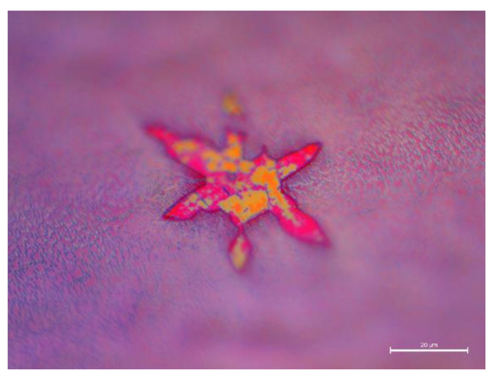

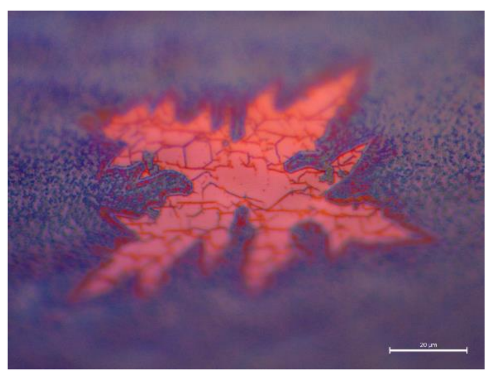

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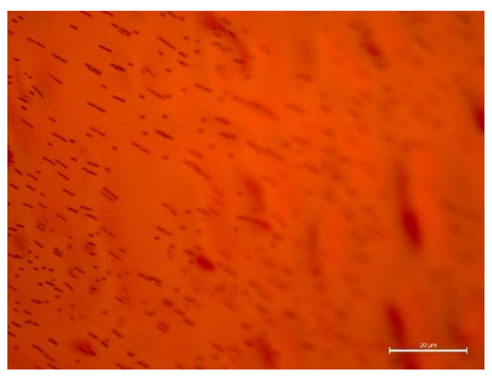
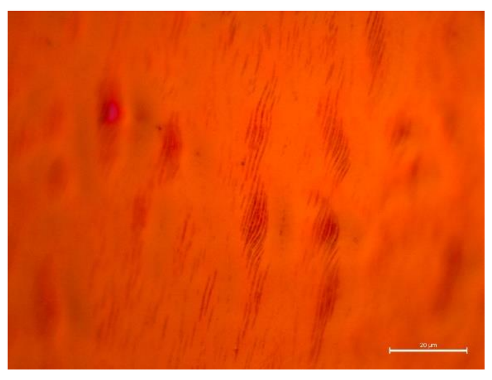
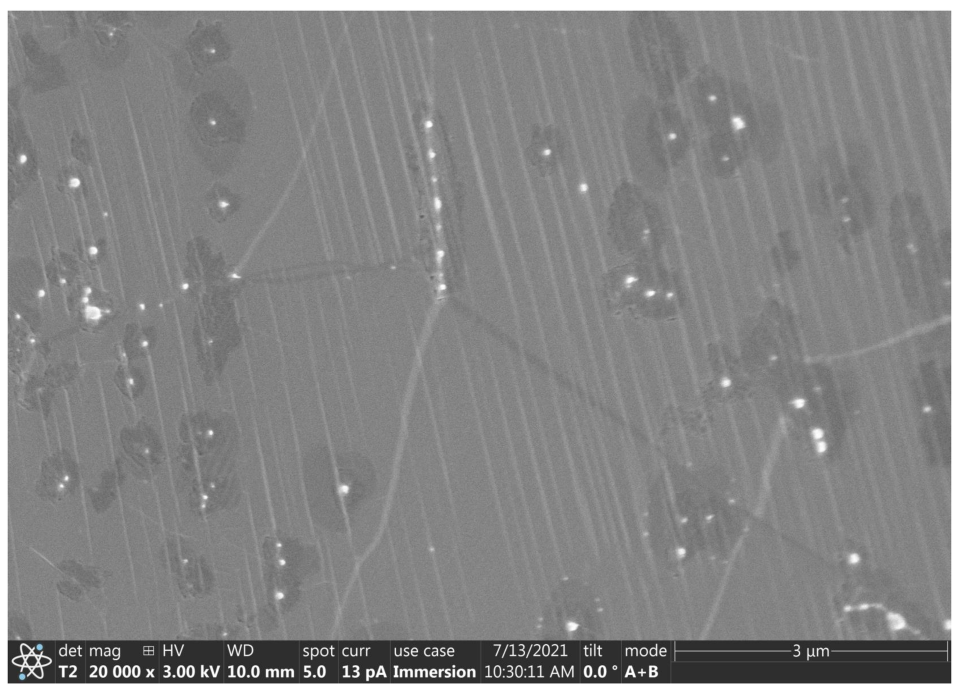




During our experiments of graphene growth at elevated temperatures a problem we encountered was that part of the copper would get stuck to the quartz boat, causing wrinkling of the copper during cooling. We solved this by substituting the quartz boat with a BN boat, to which the copper will not get stuck due to the low metal wettability of BN.

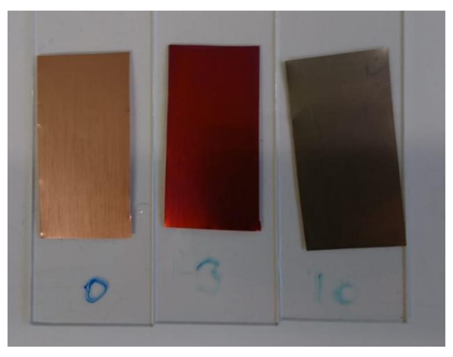
2. SiO_x Particle deposition

SEM inspection of our graphene revealed white particulates, often at the centre of multilayer sites on the graphene. Lisi et al. have attributed the occurrence of these white particles to the release of SiO_x gas from a reaction of sublimated copper with the quartz tube of the CVD oven, yielding SiO_x particles on the copper. These particles can act both as nucleation sites and etching sites.



3. Preoxidation of copper

Introduction of oxygen during the growth of graphene has been reported to yield larger single crystal domains in the resulting graphene. Here we attempted to reproduce the procedure by Wang et al., by simply preoxidizing the copper substrate on a hot plate in air before the CVD process. Wang et al. found that with oxidation, after annealing the copper had formed larger (111) grains. Moreover, it has been reported that solvated oxygen in the copper will reduce the amount of nucleation sites.



0 min preox | 3 min preox | 10 min preox

Outlook

BN confinement to shield copper from SiO_x particles

Diluted methane

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References

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Jia et al., *Scientific Reports* (2012)
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Na et al., *Applied Microscopy* (2015)
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