



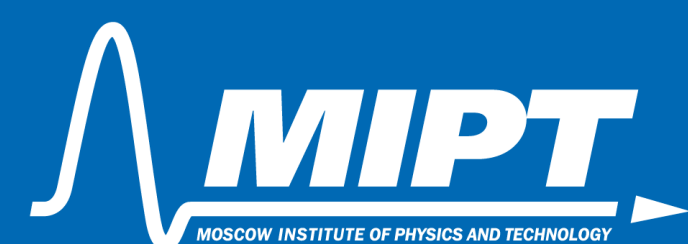
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# ULTRAFAST CVD GROWTH OF A MONOLAYER AND SINGLE-CRYSTAL GRAPHENE USING A COLD WALL REACTOR

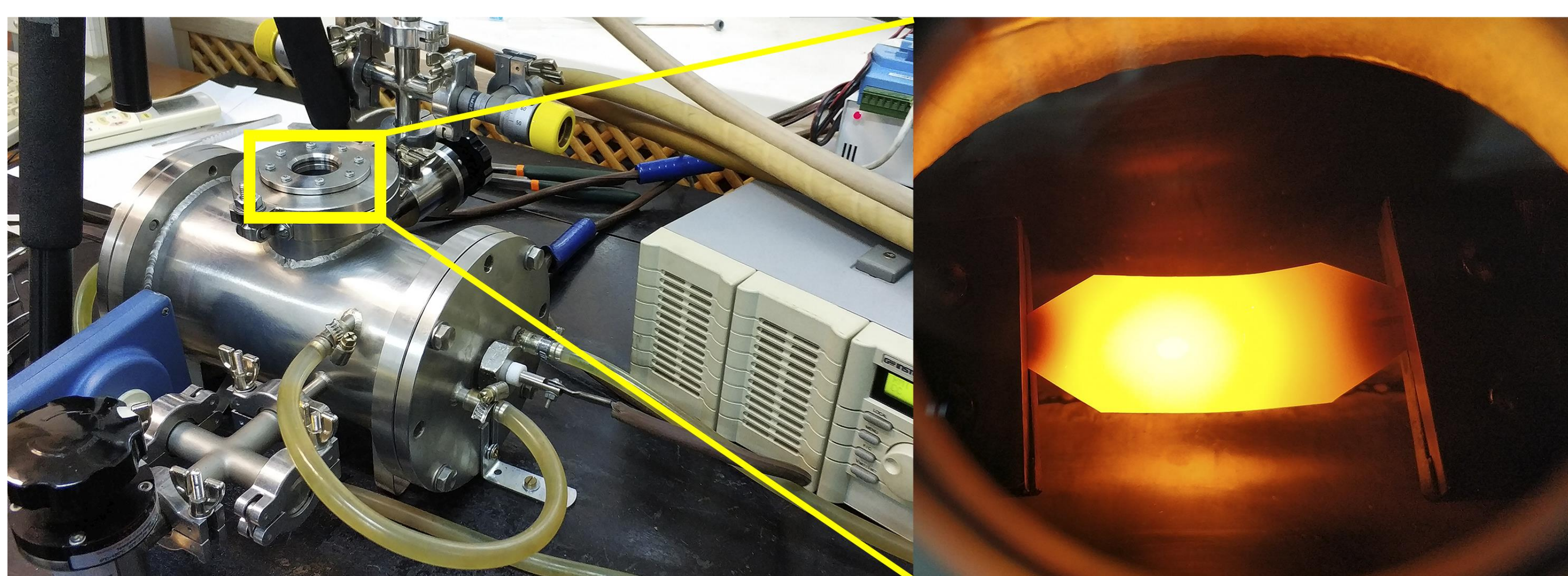


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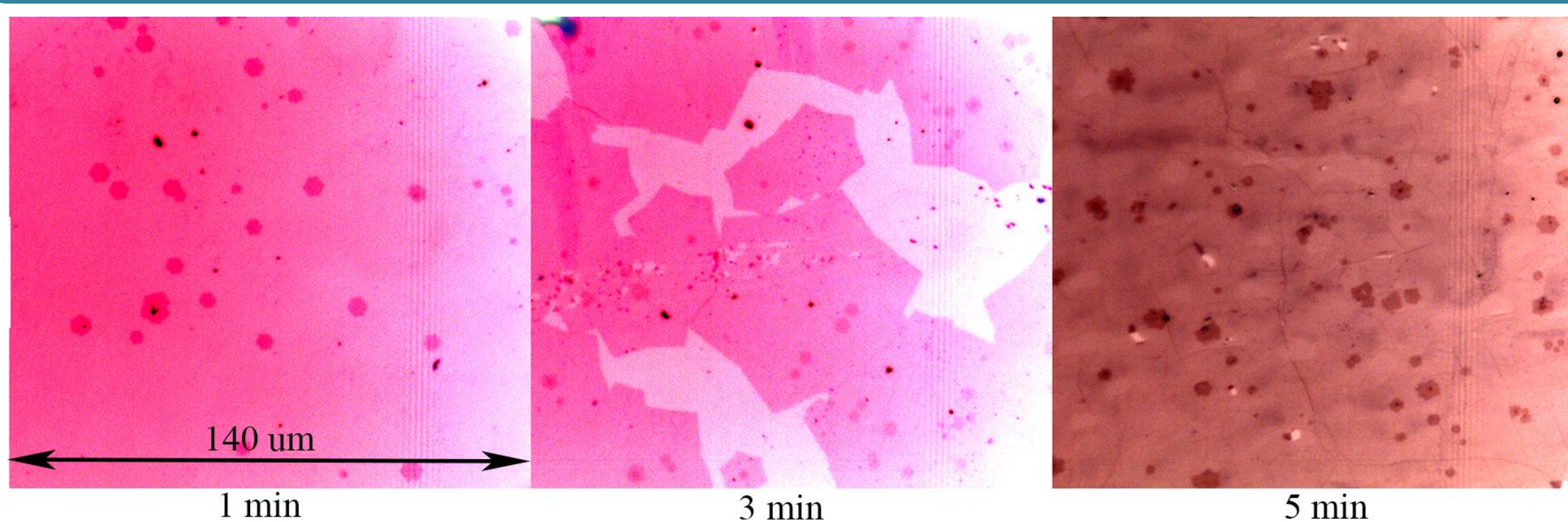
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## COLD-WALL CVD SYNTHESIS OF GRAPHENE

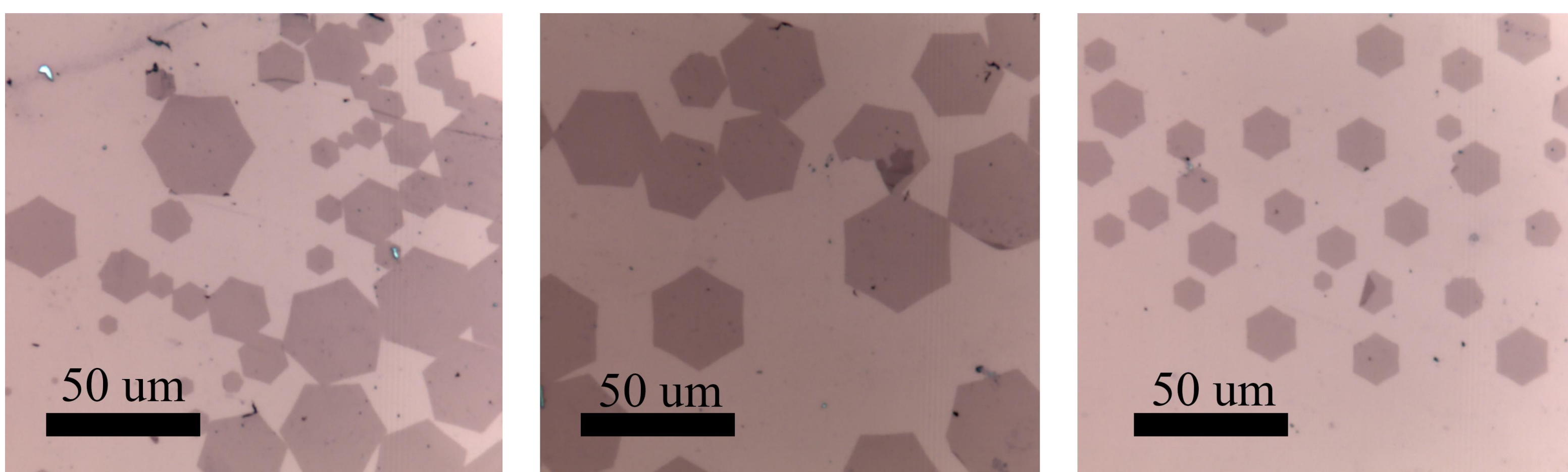


Cold wall CVD reactor (left) and a close-up of the experimental set-up during graphene growth on copper foil (right)

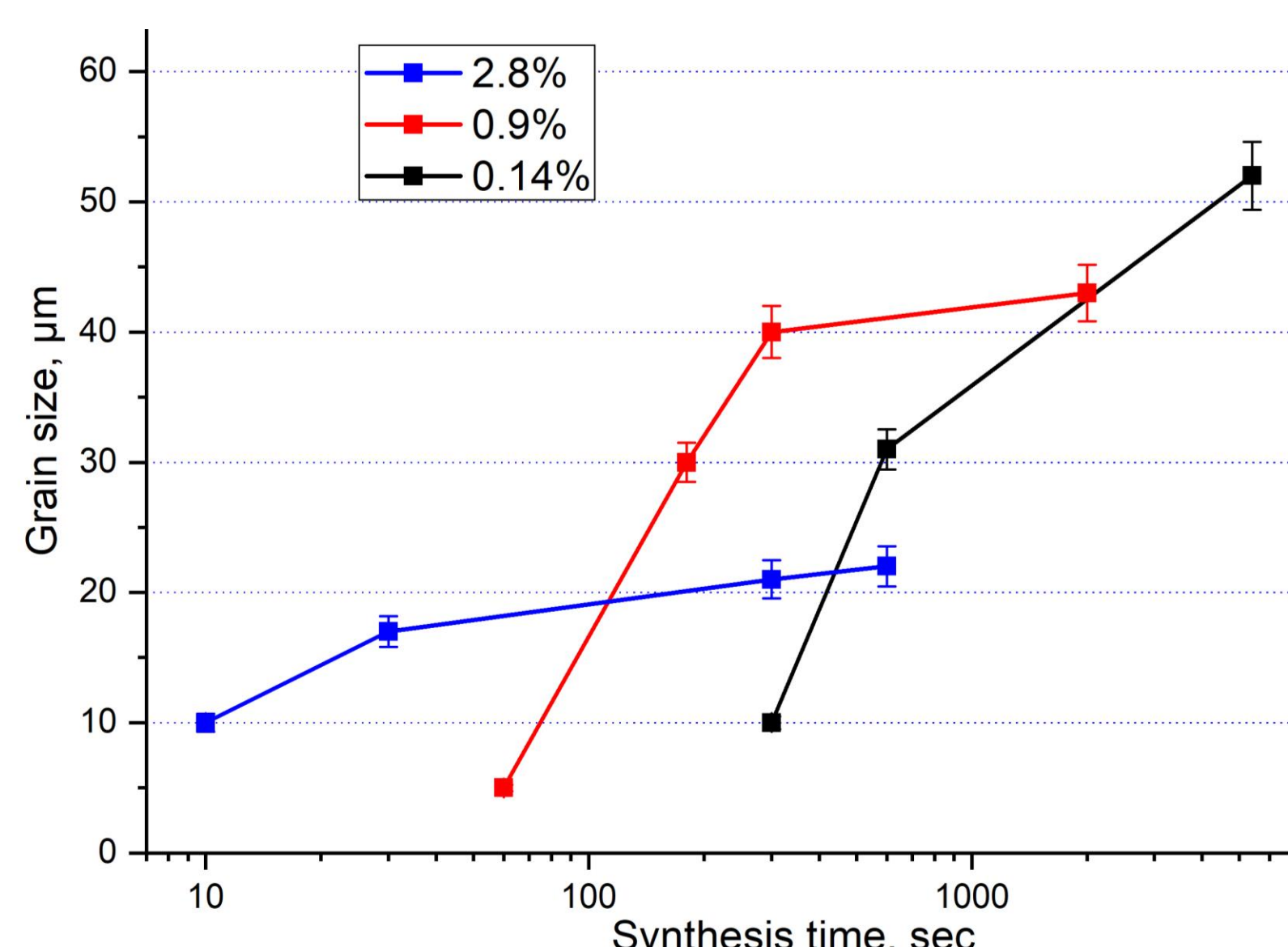
## DURATION OF SYNTHESIS



Optical images of graphene monolayer growth at different stages from nucleation's (1 min) and growth (3 min) to form the monolayer (5 min)

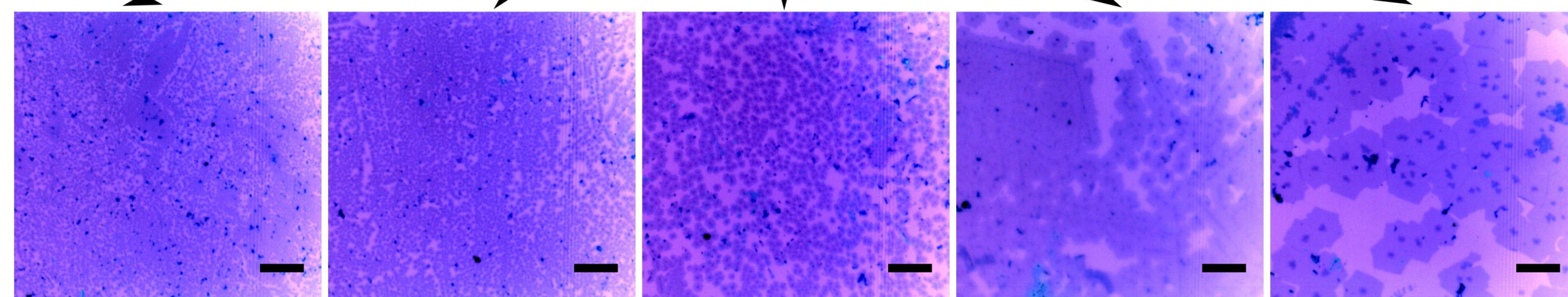
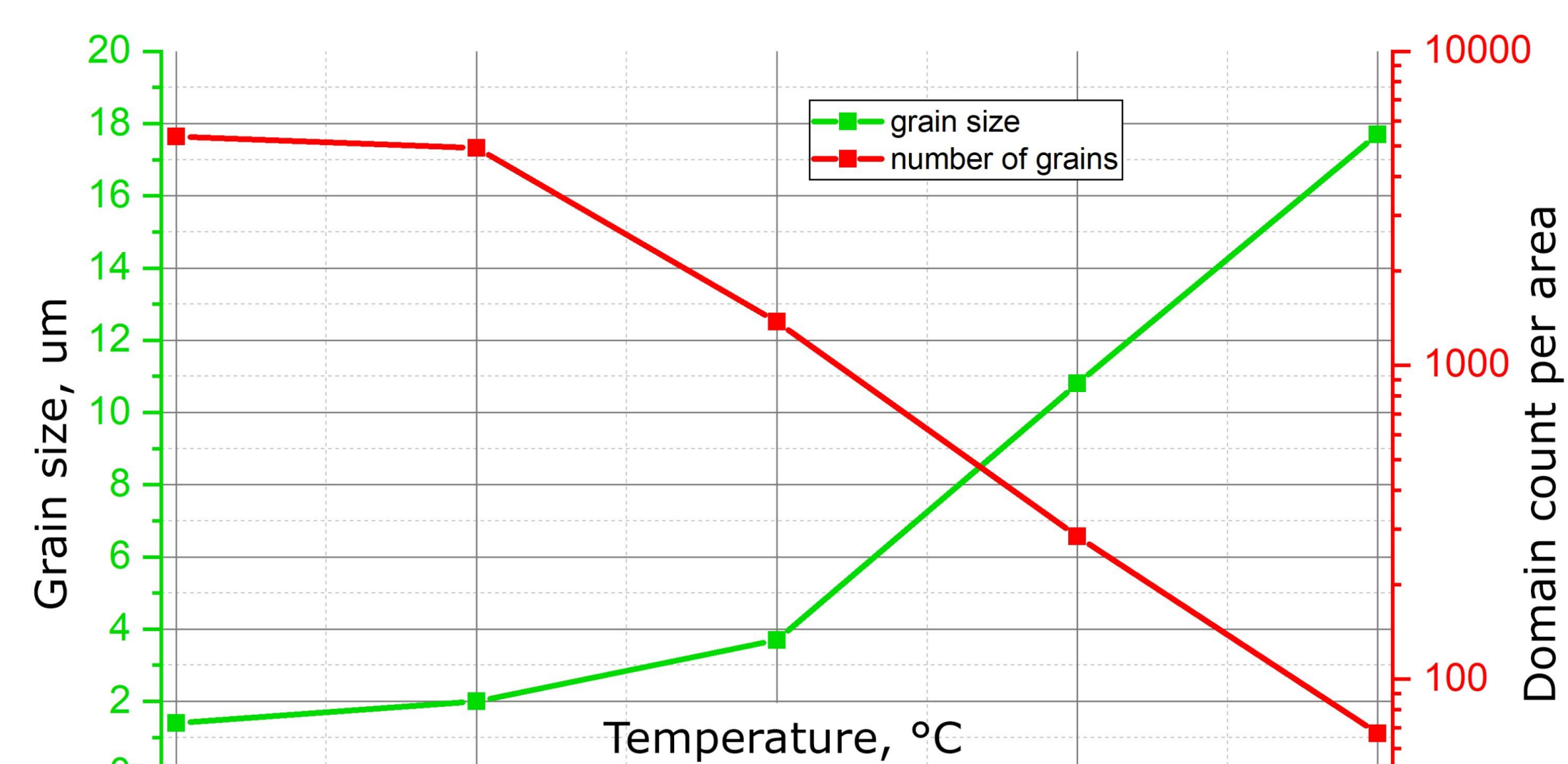


Optical images of an isolated graphene crystals transferred on Si/SiO<sub>2</sub> substrate

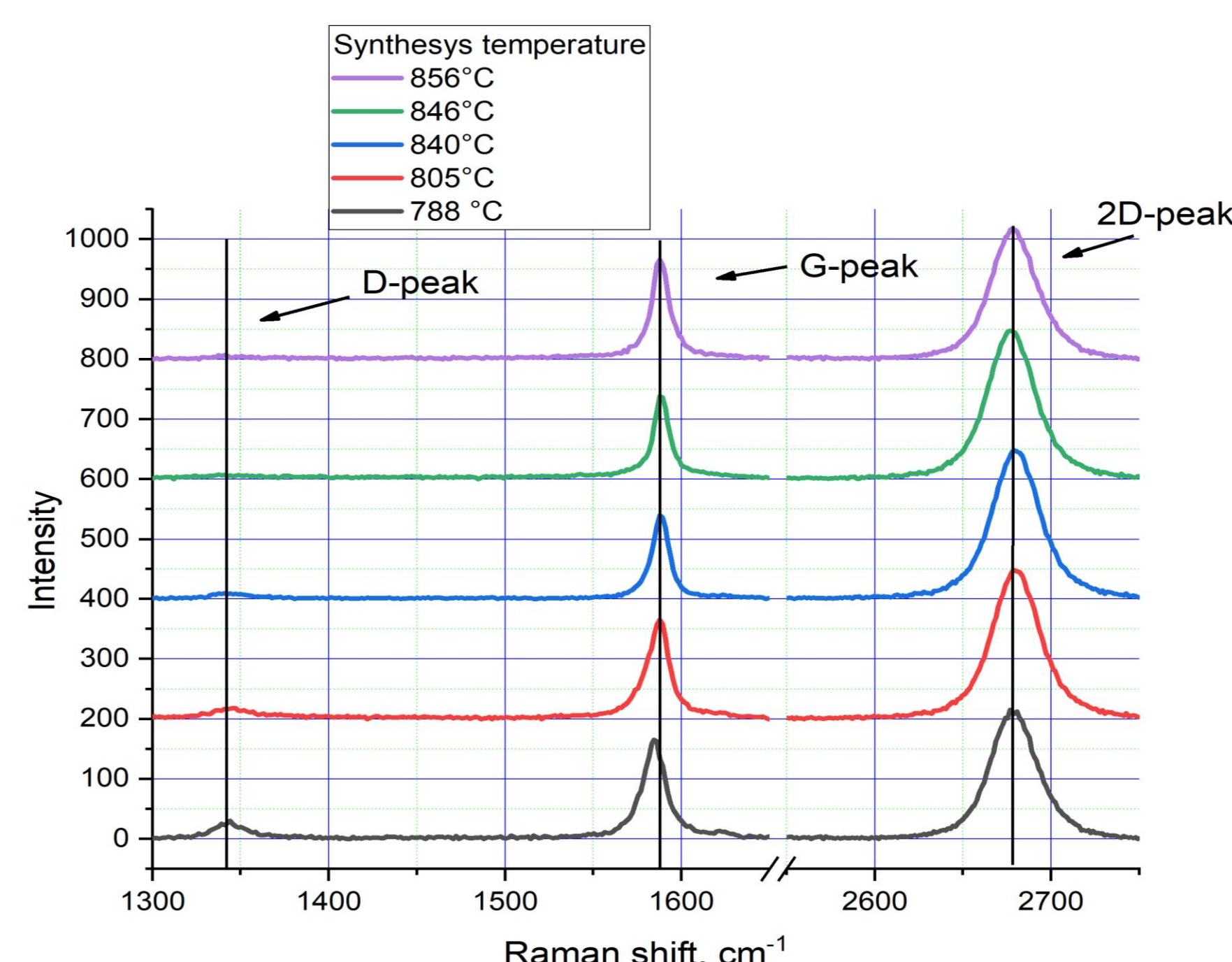


The size of graphene crystals as a function of duration synthesis at different precursor ( $CH_4$ ) concentrations.

## TEMPERATURE EFFECT

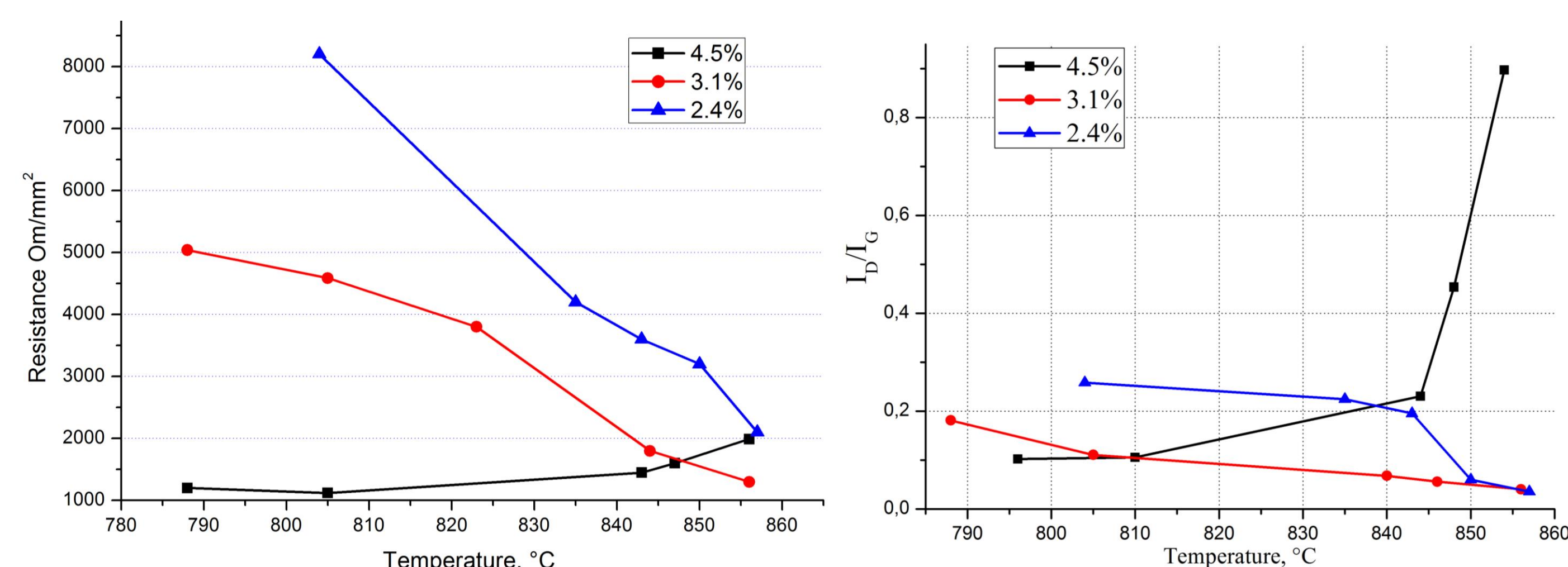


The size of graphene crystals and nucleation density as a function of growth temperature. Optical images of graphene crystals on Si/SiO<sub>2</sub> substrate at different growth temperatures. All scale bars are 20μm.



Raman spectra taken from a single-layer graphene at different growth temperatures.

## PRECURSOR CONCENTRATION



The effect of different precursor concentrations on the sheet resistance (left) and Raman D/G intensity ratio at various temperatures

## CONCLUSIONS

Graphene monolayer can be grown at record time full cycle around 3-4 minutes using high temperature and precursor concentrations. To grow a high-quality graphene, a low precursor concentration (<0.3%) should be used. Exact control of the synthesis time allows growing isolated grains and monolayers of high-quality graphene.

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