# CVD Graphene shape evolution during growth: Impact of the *in-situ* increased hydrogen partial pressure

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## Abstract

It is well known that exposing chemical vapor deposited (CVD) graphene to hydrogen gas can yield dendritic graphene shapes due to an etching process [1,2]. Here, we demonstrate that similar dendritic structures can be achieved at long growth times without the external addition of hydrogen. These structures are not a result of a diffusion controlled growth as reported before [3,4] but to the competing backward etching reaction which starts dominating over the growth during long growth times due to an in-situ increase of the hydrogen partial pressure. We have performed a systematic study on the growth of graphene as a function of time to identify the onset and evolution of graphene etching **(Fig 1)**. During hydrogen partial pressure balancing to find a process window for keeping growth ongoing, two kinds of etching mechanism (oxidative and reductive) were observed **(Fig. 2)**. In addition, we have found that the in-situ increased hydrogen graphene etching is dependent on the copper foil geometrical arrangement. Highly etched graphene with dendritic shapes was observed on unconfined copper foil regions which highlight the importance of the reactant distribution in activating the etching process during growth.

## References

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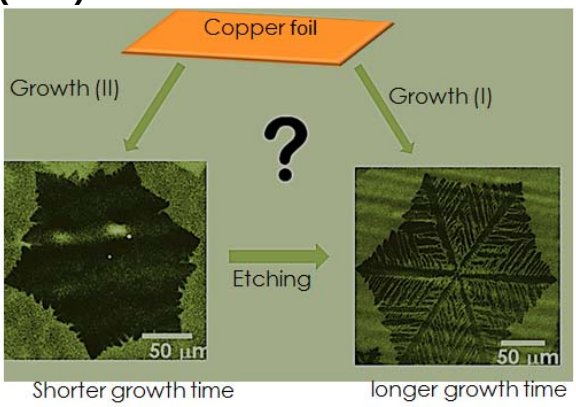


**Figure 1:** SEM images of graphene on copper foil showing the two possible mechanisms of graphene domain shape evolution.

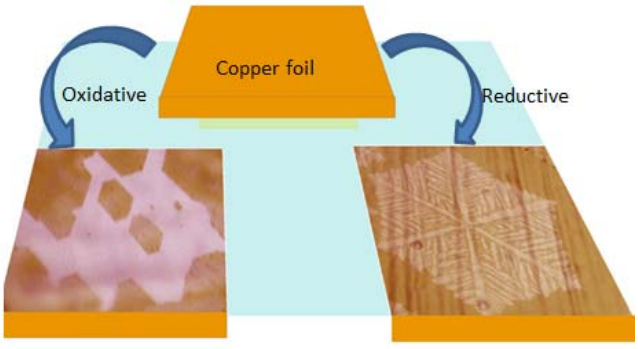


**Figure 2:** Optical microscope image showing etching at low hydrogen flow (oxidative etching, left) and high hydrogen flow (reductive etching, right).