# Liquid Based CVD Synthesis of Graphene, Doped Graphene and Their Energy Application

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Abstract

Graphene has attracted a great deal of attention because of its unique band structure and electronic properties which make it promising for applications in next-generation electronic devices, transparent flexible conducting electrodes, and sensors. Here, we report the substrate selective growth of centimeter size (~3.5 cm x 1.5 cm), uniform, and continuous single and few-layer graphene films employing chemical vapor deposition technique on polycrystalline Cu foils using liquid precursor hexane.

Since, the flat layers of atomically thin conducting graphene offers new designs for thin film energy storage devices with good performance. Here, we also report an "in-plane" fabrication approach for ultrathin supercapacitors based on electrodes comprised of pristine graphene and multilayer reduced graphene oxide. The in-plane design is straightforward to implement and exploits efficiently the surface of each graphene layer for energy storage. The open architecture and the effect of graphene edges enable even the thinnest of devices, made from as grown graphene layers, to reach specific capacities up to 80 μF $cm^{-2}$.

As we know that carbon-based rechargeable batteries have gained extensive attention, after the commercialization of Li-ion battery, on top of that chemical doping of boron, nitrogen and phosphorous etc. have increased the specific capacity of battery. So, here we have also demonstrated a controlled growth of nitrogen-doped graphene layers by liquid precursor based CVD technique. Nitrogen-doped graphene was grown directly on Cu current collectors and studied for its reversible Li-ion intercalation properties. Reversible discharge capacity of N-doped graphene is almost double compared to pristine graphene due to the large number of surface defects induced due to N-doping.

References

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Figures

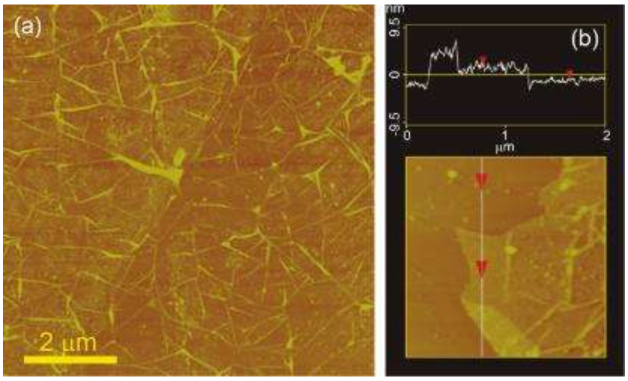


**Figure 1:** AFM image of CVD-grown graphene transferred onto a $SiO_2$ substrate. It is clearly evident that the films are uniform and highly continuous. The wrinkles formed on the films during transfer are also clearly visible. The linear thickness analysis also shows that the films are about 1.5 nm thick.