

Nanoelectronics Undergraduate Research Fellowship (NURF) 2010 Project Summary

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 Project title: Uniformity of Graphene on Copper

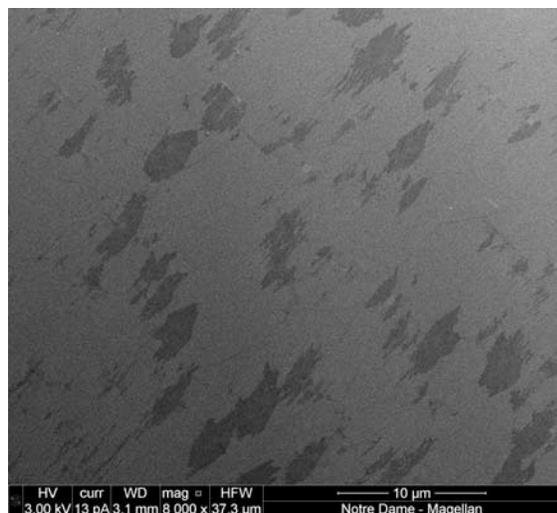


Figure 1. SEM picture of graphene grown on copper foil. Conditions during growth: CH₄-20 sccm, H₂- 100 sccm, temperature-1000 °C, pressure-.862 Torr.

The first time the experiment was performed, a sample was heated starting at a half hour with half hour increments up to three hours. After inspecting the sample under the microscope small defect areas that grew as the heating time was increased were found. A series of nine experiments was performed to learn more about the defects found. The samples were analyzed using different techniques: SEM, optical microscope, and Raman. While there is still work to be done, it was concluded that the defect areas change depending on the temperature, gas ratio, and pressure during the growth phase and also that the position of the sample inside the furnace might be an important factor.

The goal of the project was to grow graphene, a single carbon layer, under different growth conditions and determine the uniformity of the carbon layer. Graphene was grown on a copper foil by Chemical Vapor Deposition. The variables changed during the growth phase were temperature, pressure and gas ratio. Because copper oxidizes at high temperatures, the idea was to grow graphene and then heat it up to 200 °C. The area covered by graphene would remain intact while the areas where the graphene was defective would oxidize.

Experiment	Avg. Size [μm ²]	Area Fraction	Count/cm ² [x10 ⁶]	Standard Deviation
1	3.911	18.5	5.04	1.66
2	4.822	19.9	4.14	.242
3	5.111	20.6	3.82	.732
4	4.767	17.1	3.76	.716
5	6.133	23.4	3.75	.690
6	4.544	18.4	4.2	.668
7	4.611	20.6	4.52	.528
8	4.167	18.7	4.55	.772
9	6.638	21.6	3.52	.679

Figure 2. Table showing the area covered by defect spots, their count per cm², average size and standard deviation on the set of nine experiments performed. The temperature, gas ratio and pressure were varied in each of the experiments.