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(Research Article)

Investigation of the effect of changes in probe diameter and amount of solution on the thickness of graphene nanoflakes produced in the liquid phase utilizing ultrasonic probe

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Abstract

One popular method to produce 2D materials is the physical method of liquid phase exfoliation (LPE) utilizing ultrasound technique. In this research, our aim is to obtain the optimum conditions for the exfoliation of 2D materials of graphene from graphite utilizing LPE by simulation of ultrasonic waves irradiation and the pressure difference in the solution using COMSOL physics interactive. These simulations are carried on for the probe of 14 mm in diameter and 22 kHz in frequency, and then for the probe of 22 mm and 40 mm in diameter and 20 kHz frequency to obtain the maximum acoustic pressure difference in the solution. Then the probe, which the simulation shows produces the maximum acoustic pressure difference is used for the experimental investigation of the volume and the density of the graphite solution, which is irradiated by ultrasound for graphene, produced. The numerical simulations give an expectation to have more graphene exfoliation when the pressure difference in solution sonication is more. This expectation is verified by the experimentation. The experimental results which are analyzed using UV-visible spectroscopy, FESEM, TEM, and Raman spectrum show the probes with 14 mm and 22 mm produce less flakes which are in smaller size compared to the probe with diameter 40 mm which few-layer and even bilayer graphene with larger size are observed. Also we observed the density and the volume of the solution has importance in the layer number of the flakes production.

Keywords: Bilayer Graphene, Ultrasonic Probe diameter, Simulation, Raman spectrum, COMSOL software.

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