FLG flakes thickness and size control by varying the ultrasound parameters of eco-friendly LPE

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Abstract

Ultrasound-based liquid phase exfoliation (ULPE) is one of the popular top-down method of submicron-sized flakes graphene production in large quantity, reaching the industrial production requirements. As -produced material is useful for applications like a compound in inkjet for electric circuits, in printed medical and gas vapor sensors, for converting seawater into drinking water etc. [1, 2]. Some mechanisms have been discussed using ex-situ [3] and in-situ [4] analysis. A recent review on ULPE [5] emphasizes the need to produce graphene by using green and non-toxic dispersants. Our research is focused on ultrasonic (US) cavitation technology in pure water-graphite solutions, as a single step process for graphene exfoliation. We have shown that using low frequency (Lf:20 kHz) LPE in water we can obtain MLG flakes (15 Ls) of good quality with averaged area about 1 μm^2. At a high US frequency (Hf:1.2 MHz), the thickness can be reduced to FLG flakes of 7 Ls in average. Combining two US sources not only reduces FLG flakes thickness to 3 Ls in average (Fig. 1) but also increases the flake area to 1 – 2 μm^2. The crucial US parameters such as pressure were established by complex investigation including in-situ acoustical measurement and post-processing characterisation (Raman, UV-vis and TEM).

References

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Figures

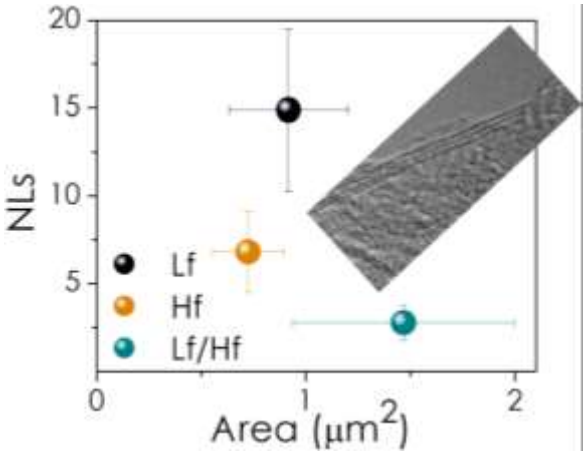

Figure 1: TEM results presented as the averaged data of surface area and NLs for different UPLE set-ups. Inset is HR TEM representative image of 3Ls graphene edge.