Critical Parameters in Exfoliating Graphite into Graphene

Oren Regev, **Matat Buzaglo, Michael Shtein, Sivan Kober, Robert Lovrincic, Ayelet Vilan**

Department of Chemical Engineering and Ilse Katz Institute for Nanoscale Science and Technology, Ben-Gurion University of the Negev, Beer-Sheva 84105, Israel
oregev@bgu.ac.il

Abstract
Dispersing graphite into few-layers graphene sheets (GS) in water is very appealing as an environmental-friendly, low-cost, low-energy source of graphene. Very high GS concentrations in water (0.7 $mg \cdot mL^{-1}$) were obtained by optimizing the nature of dispersant and the type of ultra-sonic generator. We find that a multi-step sonication procedure involving both tip and bath sources considerably enhances the yield of exfoliated GS (Figure 1). Raman and transmission electron microscopy indicate few-layers graphene patches with typical size of ~0.65 µm in one dimension and ~0.35 µm in the other (Figure 2). These were further employed in combination with water-dispersed CNT to fabricate conductive transparent electrodes for molecularly-controlled solar-cell with an open-circuit voltage of 0.53 V (Figure 3).

References

[1] Oren Regev, Matat Buzaglo, Michael Shtein, Sivan Kober, Robert Lovrincic, Ayelet Vilan, Physical Chemistry Chemical Physics, (2013) in press.

Figures

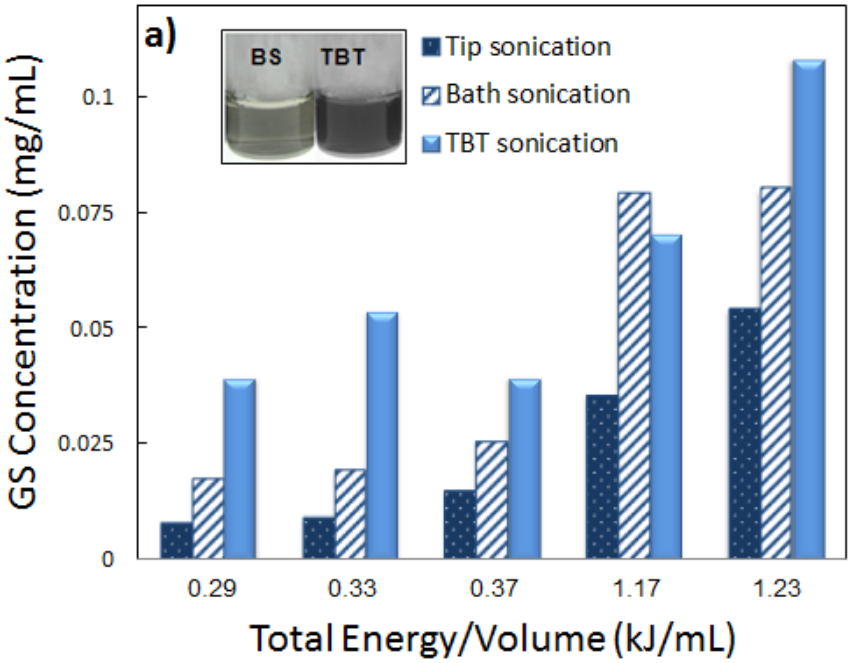

Figure 1: Optimization of sonication procedure, dispersant and energy/volume. (a) GS concentrations upon bath sonication (BS), tip sonication (TS) and tip-bath-tip sonication (TBT). *Inset*: Image of the supernatant of the GS dispersions after centrifugation

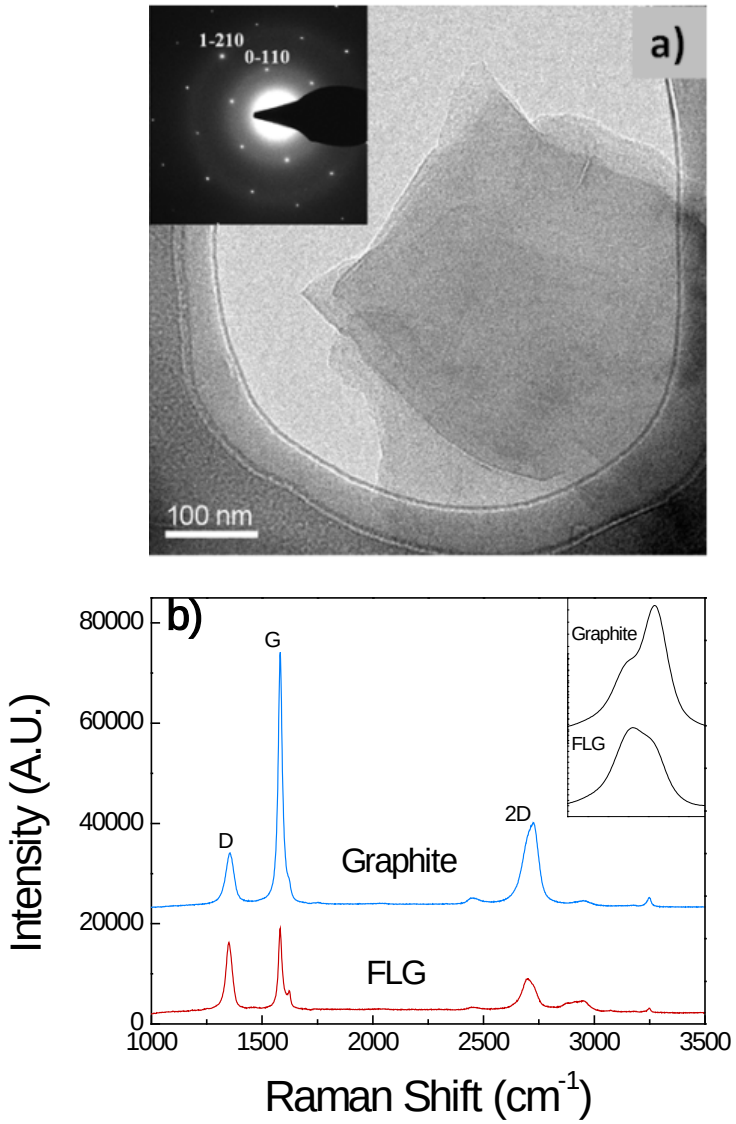

Figure 2. Indication for few layers of graphene showing a) Room temperature TEM micrographs of GS stacks from GS-TX-100. The diffraction pattern (*inset*) indicates that the GS are less than 5 layers thick, b) the Raman spectra of graphene film on quartz substrate at 514 nm. *Inset* shows a zoom-up of the 2D peak.

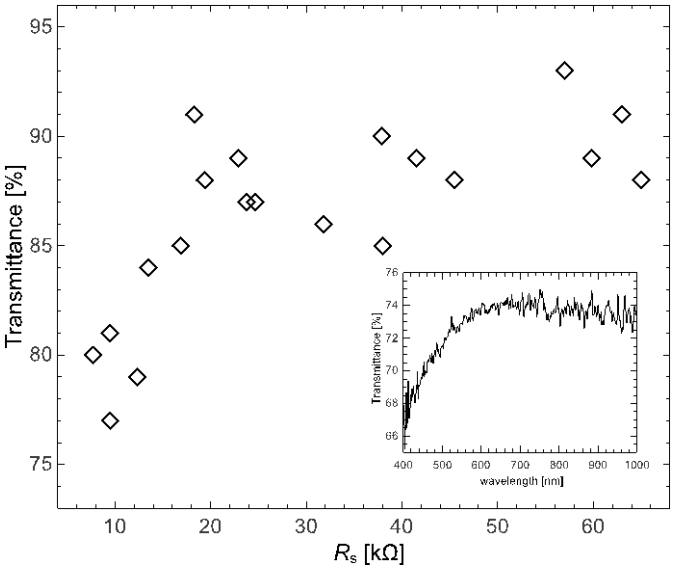

Figure 3. Transmittance (*T*) vs. sheet resistance (R_s) for mixed GS-CNT films spin-coated on glass substrates. Transmittance values are averaged and use the bare glass substrate is the reference. The inset shows a typical transmittance spectrum.