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# Graphene-based composite with high stable dispersion in ethanol.

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## Abstract

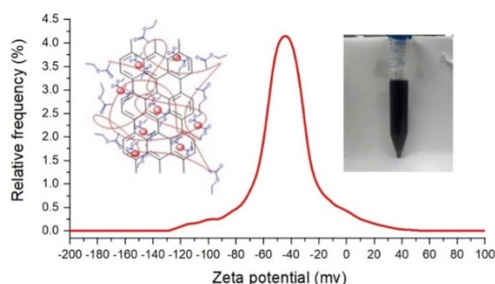
Graphene is a 2D carbo-material with very particular physical features such as electro-conductivity, thermo-conductivity, mechanical stability, and its peculiar aspect ratio with a high surface and a negligible thickness (<sup>1-3</sup>). Graphene can be dispersed at high concentration only in polar aprotic solvent such as n-methyl-2-pyrrolidone or dimethyl formamide (<sup>4</sup>) both solvents with a high boiling point and high toxicity for the human and the environment.

For these reasons is preferred to use the oxidised form of graphene, graphene oxide (GO), most easy to disperse, and reduce it to reducer graphene oxide (rGO). However, GO have more defects on the surface than pristine graphene losing a part of the natural performance of the graphene.

Other solutions to solubilise/suspend pristine graphene is the use of molecular surfactant (<sup>5</sup>) or polar polymer such as the PVP (<sup>6-8</sup>) to disperse of the material with a good concentration in water.

In this work a new surface modification obtained by reaction with ethyl maleate made graphene easy to disperse in organic polar solvents such as ethanol. Uncontrolled growing of polymer (ethyl maleate derivate) on the surface of the material was performed by microwave reactor that allows the formation of of polymer maleate on the surface of the graphene. This material has good stability in ethanol and maintains that feature after a long time.

This process allows production of graphene-based inks or the deposition on other surfaces by simply removal of the solvent. At the same time the polyethylmaleate can be removed by simply ablation originated from heating of the material in an inert atmosphere to obtain pristine graphene with a low number of defects.



Graphene with poly maleate stability in ethanol

## References

1. Clancy AJ, Bayazit MK, Hodge SA, Skipper NT, Howard CA, Shaffer MSP. Charged Carbon Nanomaterials: Redox Chemistries of Fullerenes, Carbon Nanotubes, and Graphenes. *Chem Rev.* 2018;118(16):7363-7408. doi:10.1021/acs.chemrev.8b00128
2. Randviir EP, Brownson DAC, Banks CE. A decade of graphene research: Production, applications and outlook. *Mater Today.* 2014;17(9):426-432. doi:10.1016/j.mattod.2014.06.001
3. Wei W, Qu X. Extraordinary physical properties of functionalized graphene. *Small.* 2012;8(14):2138-2151. doi:10.1002/smll.201200104
4. Vacacela Gomez C, Guevara M, Tene T, et al. The liquid exfoliation of graphene in polar solvents. *Appl Surf Sci.* 2021;546(December 2020):149046. doi:10.1016/j.apsusc.2021.149046
5. Wang S, Yi M, Shen Z, Zhang X, Ma S. Adding ethanol can effectively enhance the graphene concentration in water-surfactant solutions. *RSC Adv.* 2014;4(48):25374-25378. doi:10.1039/c4ra03345k
6. Laaksonen P, Kainlahti M, Laaksonen T, et al. Interfacial engineering by proteins: Exfoliation and functionalization of graphene by hydrophobins. *Angew Chemie - Int Ed.* 2010;49(29):4946-4949. doi:10.1002/anie.201001806
7. Perumal S, Lee HM, Cheong IW. High-concentration graphene dispersion stabilized by block copolymers in ethanol. *J Colloid Interface Sci.* 2017;497:359-367. doi:10.1016/j.jcis.2017.03.027
8. Wajid AS, Das S, Irin F, et al. Polymer-stabilized graphene dispersions at high concentrations in organic solvents for composite production. *Carbon N Y.* 2012;50(2):526-534. doi:10.1016/j.carbon.2011.09.008