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MICROMECHANICAL CHARACTERIZATION OF OXIDIZED CARBON NANOTUBE AND GRAPHENE OXIDE PAPERS

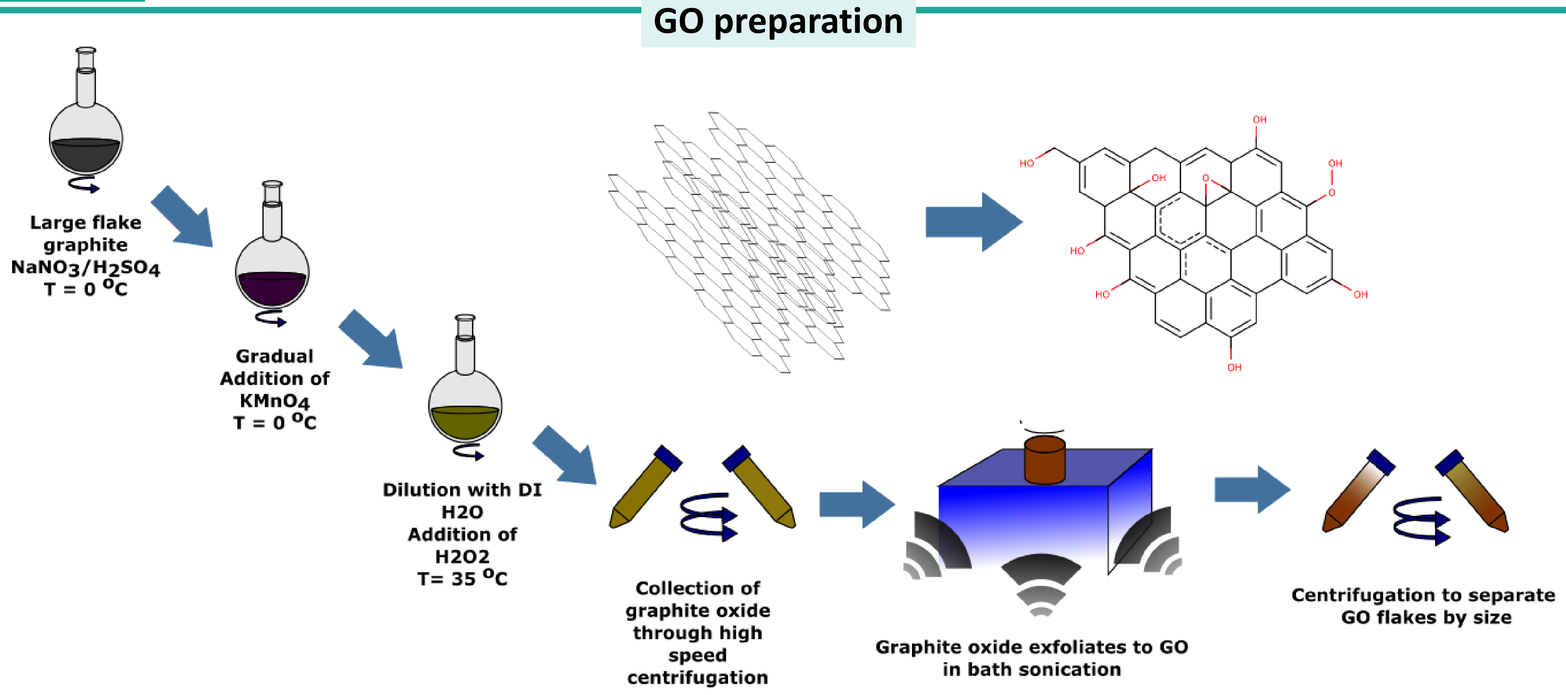
Christos Kostaras[1,2], Christos Pavlou[1,2], George Paterakis[1,2], Nikolaos Koutroumanis[1,2], George Trakakis[2], Costas Galiotis[1,2]

1 Department of Chemical Engineering, University of Patras, 26504 Patras, Greece
2 FORTH/ICE-HT, Stadiou Str., 26504 Rion Patras, Greece

ABSTRACT In the present work the endurance of graphene oxide and oxidized MWCNT papers on tensile stress is tested. Graphite oxidation and exfoliation and $KMnO_4$ reaction of MWCNTs are employed to produce GO and oxidized carbon nanotubes respectively. Hybrid GO/OMWCNT papers that exhibit GO weight percentage that ranges from 0 wt% to 100 wt% are fabricated by vacuum filtration and are subjected to tensile testing. Results across the whole sample range show a general increase in stress at failure for higher GO contents. The increasing stiffness of the samples tested is indicative of the formation of hydrogen bonds between the hydroxyl and carboxylic acid functionalities [1] of the decorated nanoparticles brought on by the more ordered stacking of GO nanoparticles.

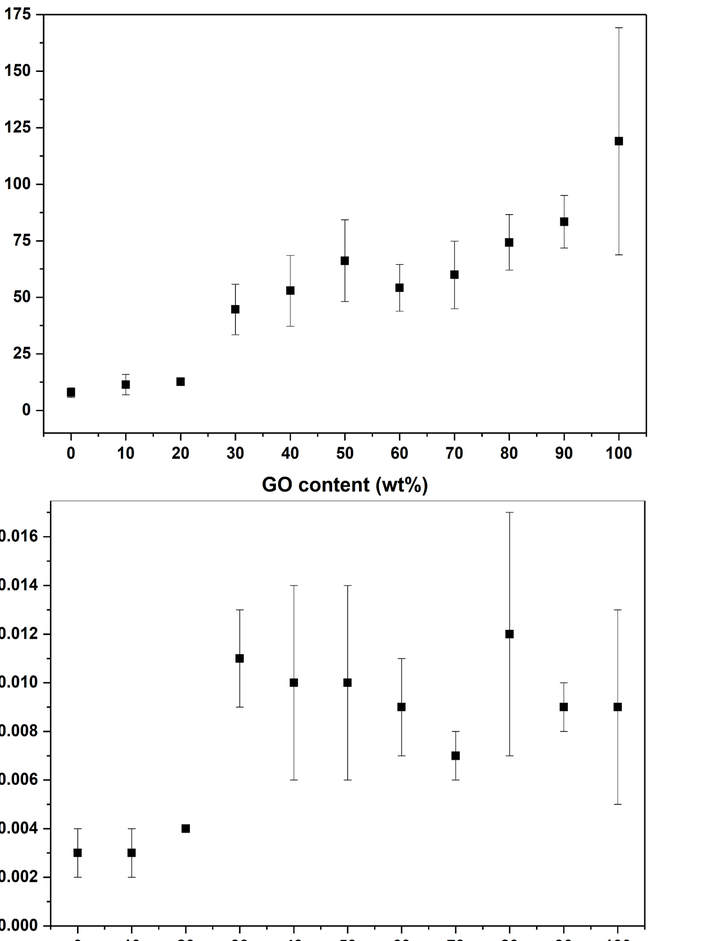
RESULTS

GO preparation

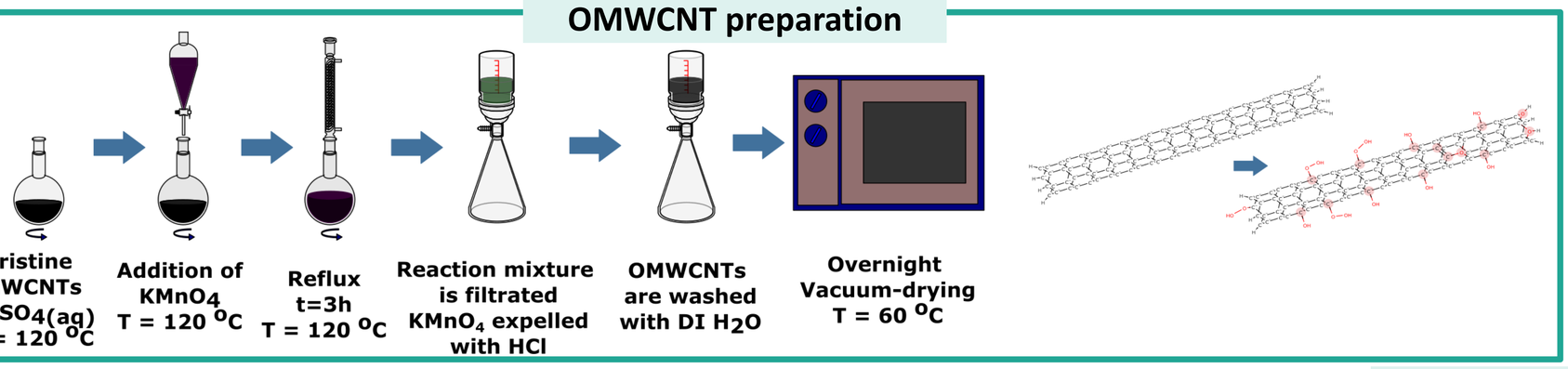


- GO was produced from graphite oxide through a scalable modified Hummer's method [2].
- Pristine MWCNTs are oxidized with $KMnO_4$ in an acidic environment [3].
- Hydroxyl and carboxylic acid functionalities allow for easy dispersion in water and formation of stable suspensions
- GO/OMWCNT papers of varying weight ratios are easily formed using vacuum filtration of corresponding suspensions in water.

Vacuum Filtration



OMWCNT preparation



- Samples are cut in strips and mounted on paper frames with a gauge length of 25 mm [4] to undergo tensile measurements on a micromechanical testing apparatus (Deben Ltd., UK).
- **(a)** Stress (σ) – strain (ε) curves for all samples show elastic deformation behavior that gradually switches to that of plastic deformation.
- **(b)** Values for stress at failure (UTS) make a relatively sharp increase for samples with 30 wt% GO content and above, increasing then slowly until 100 wt% GO content.
- **(c)** Young's modulus shows an increase for increasing GO weight fraction, with higher value for pure GO papers.
- **(d)** Excluding samples with less than 30 wt% GO strain at failure remains relatively stable.
- The amelioration of mechanical properties for increasing GO content can be attributed to the increase of compactness of the samples due to the two-dimensional geometry of GO.

GO wt%	0	10	20	30	40	50	60	70	80	90	100
Thickness (μm)	22	20	17	17	16	13	11	7.3	7.3	6.6	5.4

- Smaller distances between nanomaterials can also point to increased contact points and hydrogen bonding between hydroxyl containing functionalities.

Mechanical Properties

CONTACT PERSON

CHRISTOS KOSTARAS
kostaras@iceht.forth.gr

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