

# POLYURETHANE FOAM/GRAPHENE NANOCOMPOSITES

*Lorena Ugarte, Sandra Gómez-Fernández, Marian Corcuera, Arantxa Eceiza*

**GMT** “Materials + Technologies” Research Group  
Department of Chemical and Environmental Engineering, University of the Basque  
Country (UPV/EHU)

## INDEX

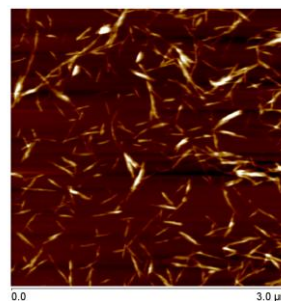
- INTRODUCTION
- LIQUID EXFOLIATION AND SIZE SELECTION OF GRAPHENE
- CHARACTERIZATION OF GRAPHENE
- PREPARATION OF NANOCOMPOSITES
- CHARACTERIZATION OF NANOCOMPOSITES
- CONCLUSIONS

## INTRODUCTION

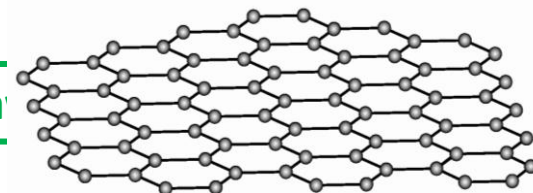
## POLYURETHANES NANOCOMPOSITES



+



Cellulose

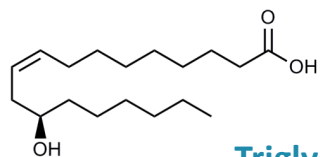


Graphene

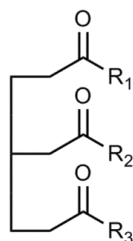
### Vegetable oils



Ricinelic acid



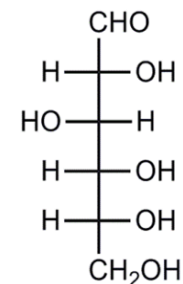
Triglycerides



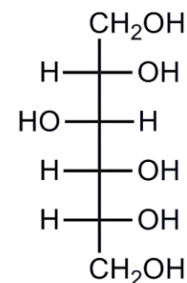
### Sugars nanocrystals



Glucose



Sorbitol



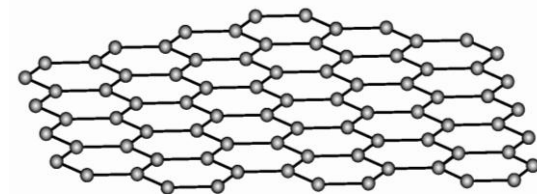
## INTRODUCTION

# POLYURETHANE FOAM/GRAPHENE NANOCOMPOSITES



Flexible polyurethane foams

+

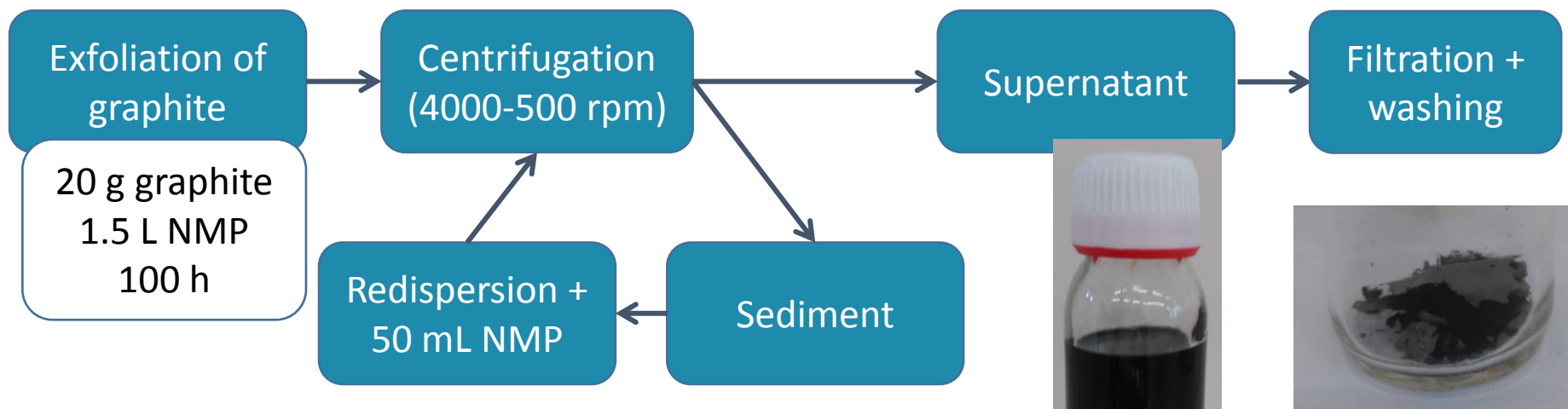


Graphene

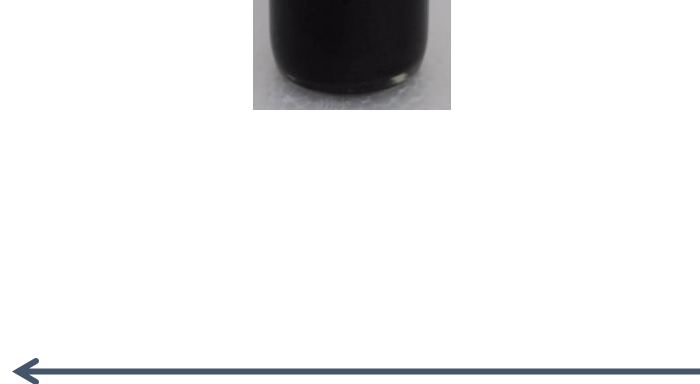
## CHARACTERISTICS

- Lightweight
- Flexibility, compressibility and stretchability
- Simplicity of preparation process
- Elastic conductor, flexible electrode and pressure sensor

## LIQUID EXFOLIATION AND SIZE SELECTION OF GRAPHENE

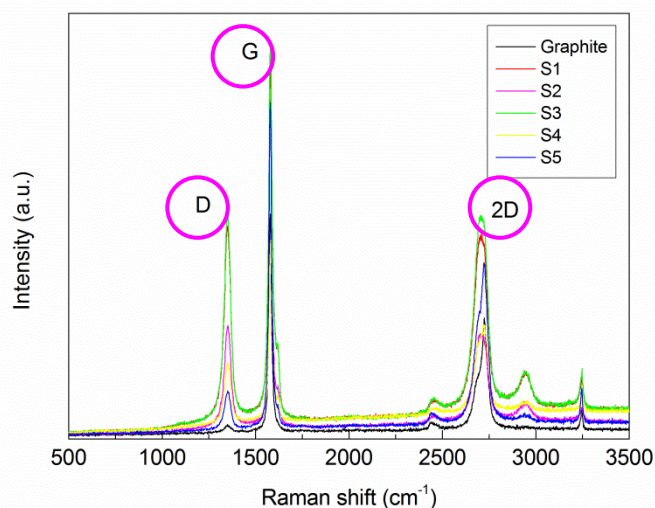


Centrifugation rate (rpm)	Designation
4000	S1
3000	S2
2000	S3
1000	S4
500	S5

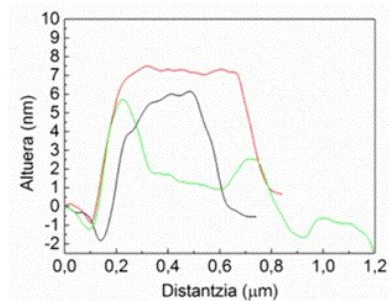
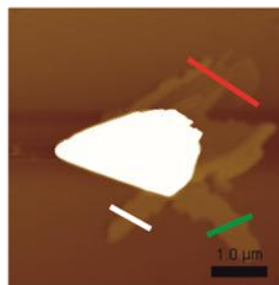




# CHARACTERIZATION OF GRAPHENE

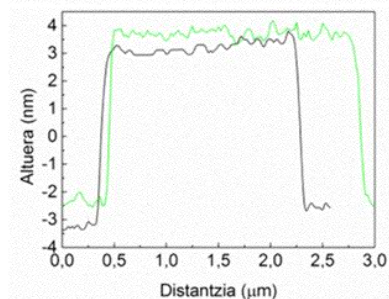
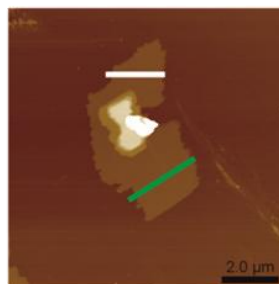


S5



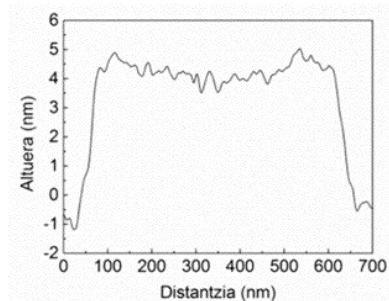
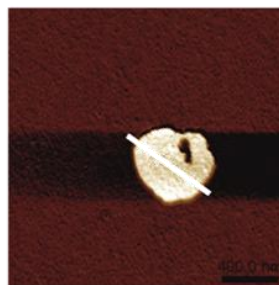
$l \sim 4\text{-}5 \mu\text{m}$   
 $t \sim 8 \text{ nm}$

S4



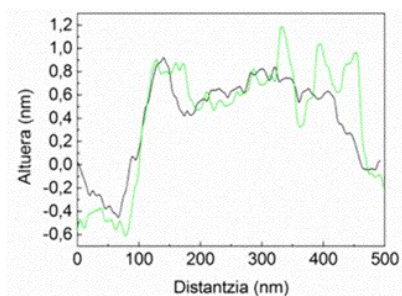
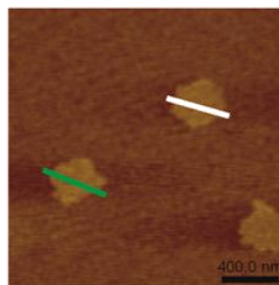
$l \sim 4\text{-}5 \mu\text{m}$   
 $t \sim 6 \text{ nm}$

S3

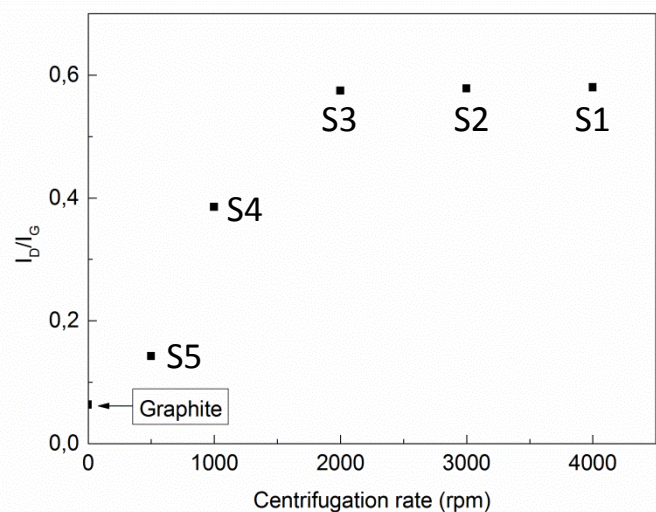


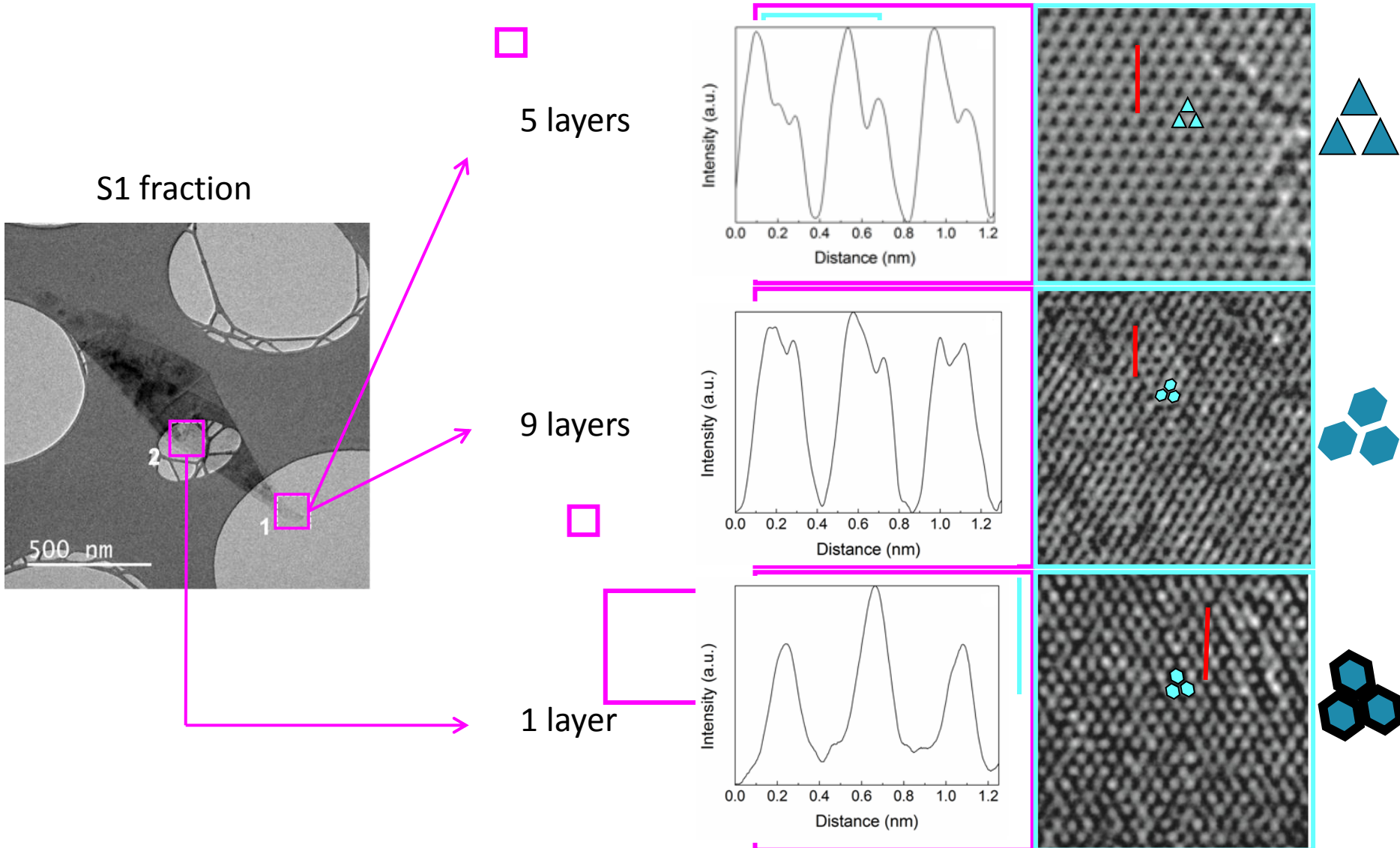
$l \sim 500 \text{ nm}$   
 $t \sim 5 \text{ nm}$

S1

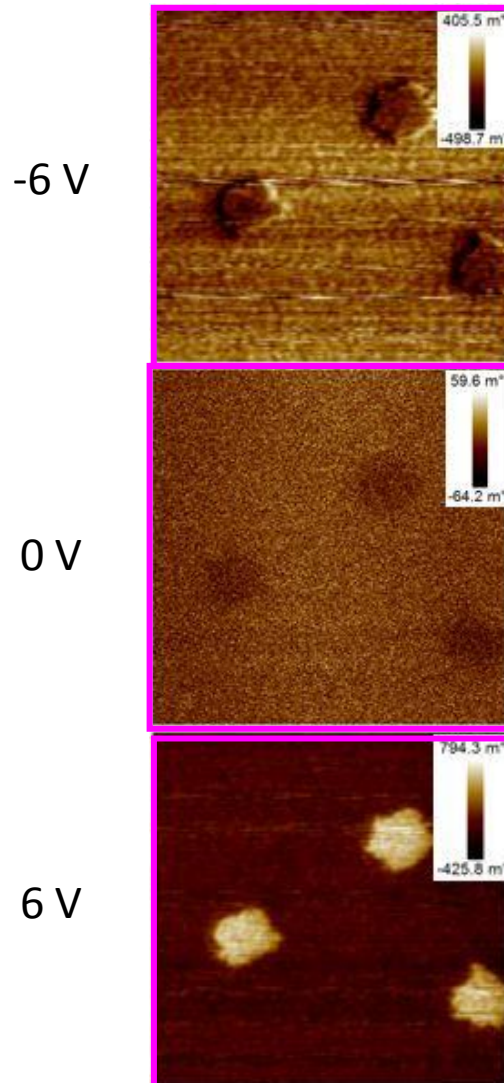


$l \sim 400 \text{ nm}$   
 $t \sim 1.5 \text{ nm}$





## CHARACTERIZATION OF GRAPHENE



Dark contrast



Attractive forces

Topography of sample has no influence on results

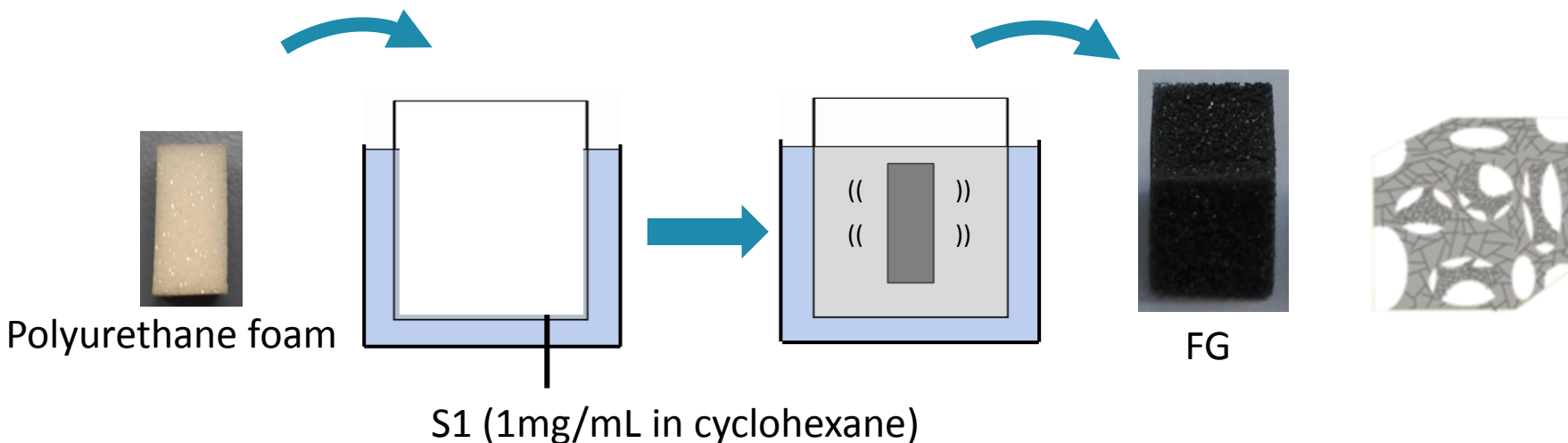
Bright contrast



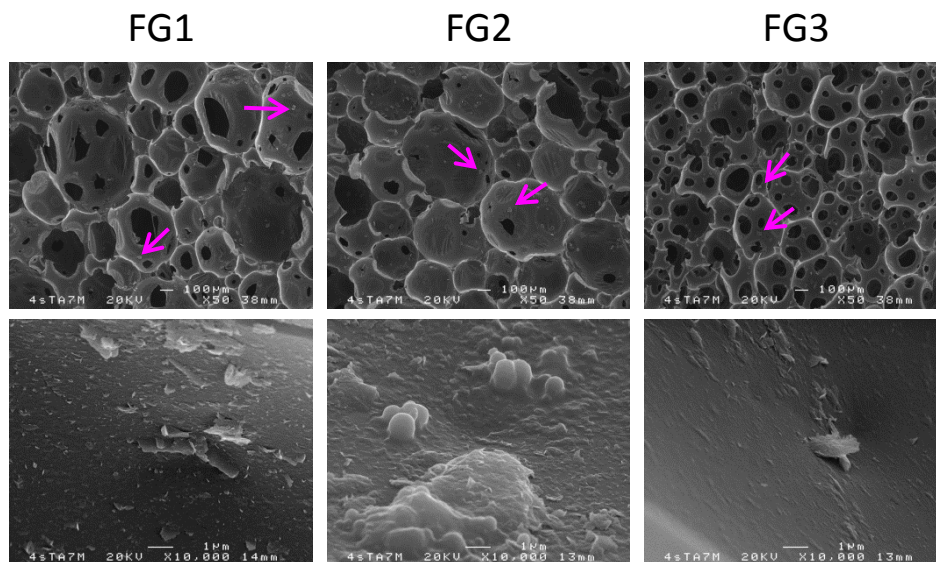
Repulsive forces



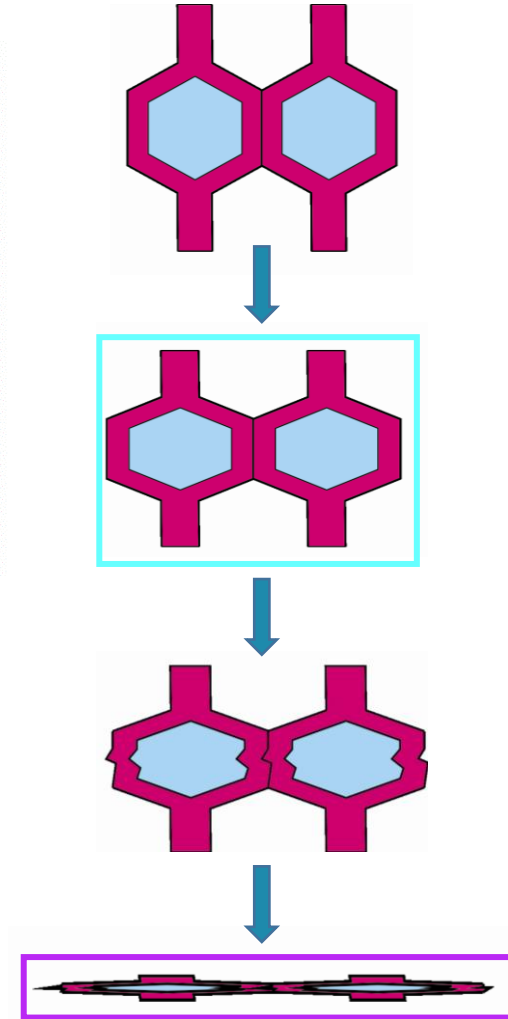
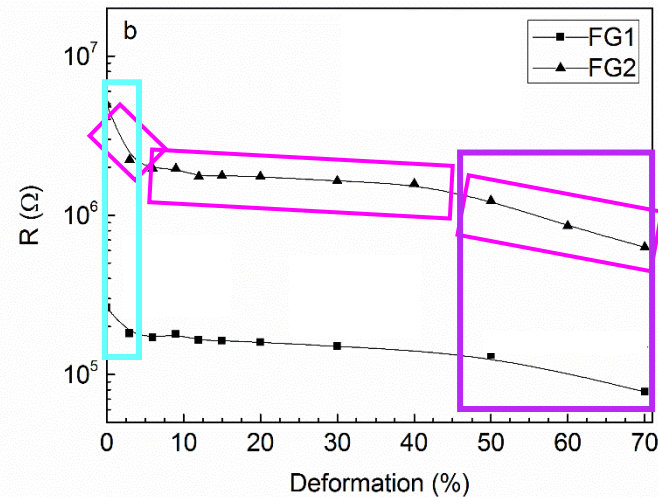
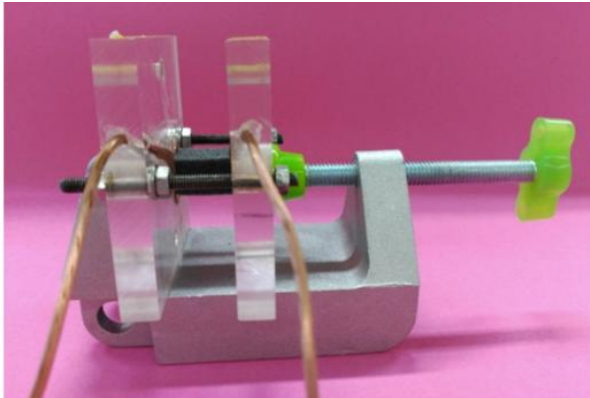
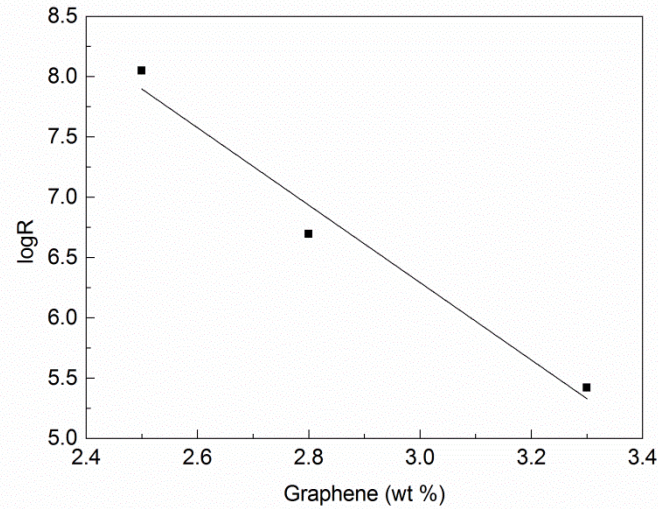
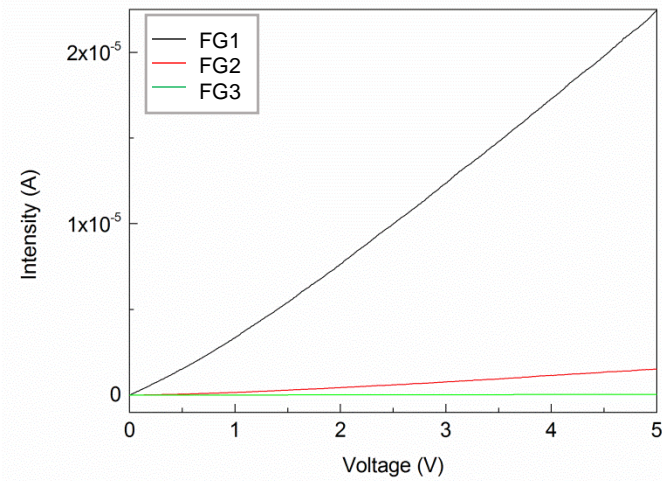
# PREPARATION OF POLYURETHANE FOAM/GRAPHENE NANOCOMPOSITES



Sample	Sonication time (min)	Graphene (wt%)
FG1	15	3.3
FG2	10	2.8
FG3	5	2.5



# CHARACTERIZATION OF NANOCOMPOSITES



## CONCLUSIONS

- Graphene was obtained by liquid exfoliation of graphite. By centrifugation, graphene fractions were separated according to flake size
- Small flakes with low number of layers were obtained in the fraction separated at the highest centrifugation rate
- Ultrasound assisted impregnation method was suitable for the preparation of polyurethane foam/graphene nanocomposites
- Graphene conferred electrical conductivity to the nanocomposites
- The electrical resistance of the nanocomposites was sensitive to mechanical deformation
- The elastic bending of cells and the structure created after cell collapse favored the contact between graphene flakes

## ACKNOWLEDGEMENTS



**UPV/EHU**  
**University of the Basque Country**  
**(PIFUPV047/2011 y Ayudas de Incorporación de**  
**Doctores Recientes)**

**Basque Government**  
**Grupos Consolidados (IT-776-13)**



**SGIKer**

# POLYURETHANE FOAM/GRAPHENE NANOCOMPOSITES

Lorena Ugarte, Sandra Gómez-Fernández, Marian Corcuera, Arantxa Eceiza



[www](http://www.ehu.eus/es/web/gmt/home)

<http://www.ehu.eus/es/web/gmt/home>



GMT Research Group