University POLITEHNICA of Bucharest
Faculty of Applied Chemistry and Materials Science

„New nanocomposites based on epoxy resins and modified multiwalled carbon nanotubes”

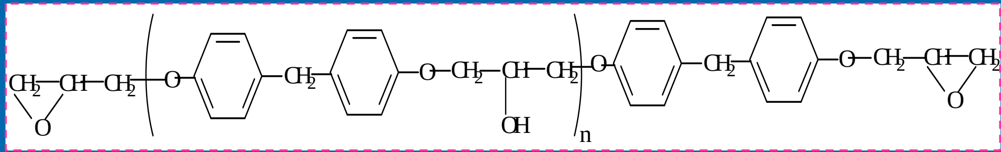
H. Iovu, S. A. Garea, C. Petrea

ADVANCED POLYMER MATERIALS GROUP

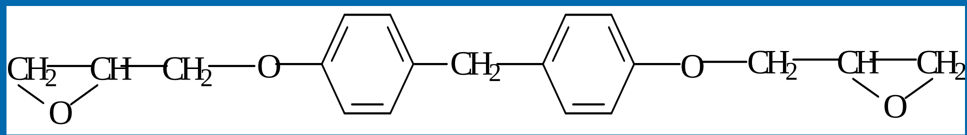
A 9-a editie a Seminarului National de nanostiinta si nanotehnologie, Academia Romana, 16.03.2010

Polymer matrix

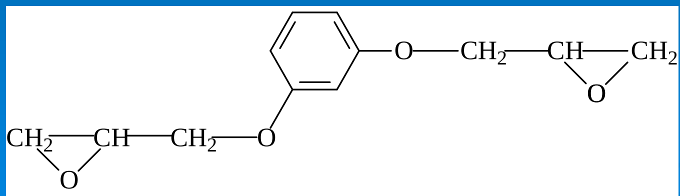
Epoxy resin



Diglycidylether of bisphenol A (DGEBA)



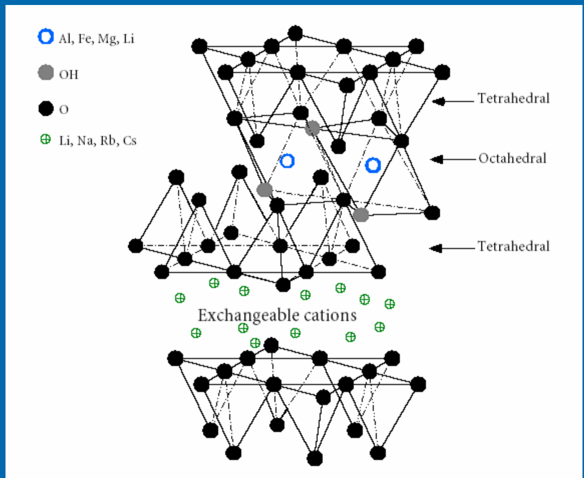
Diglycidylether of bisphenol F (DGEBF)



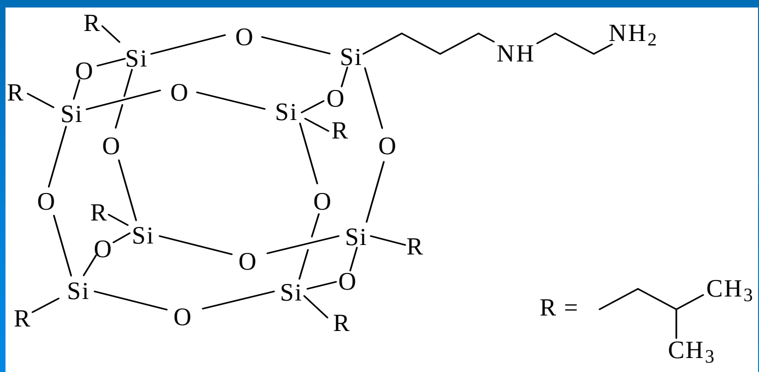
Diglycidylether of resorcinol (DGER)

Reinforcing agents

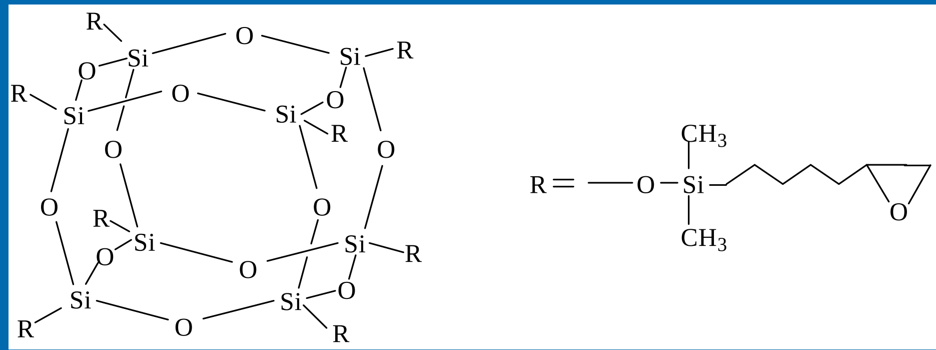
1. Layered silicate- Montmorillonite (MMT)

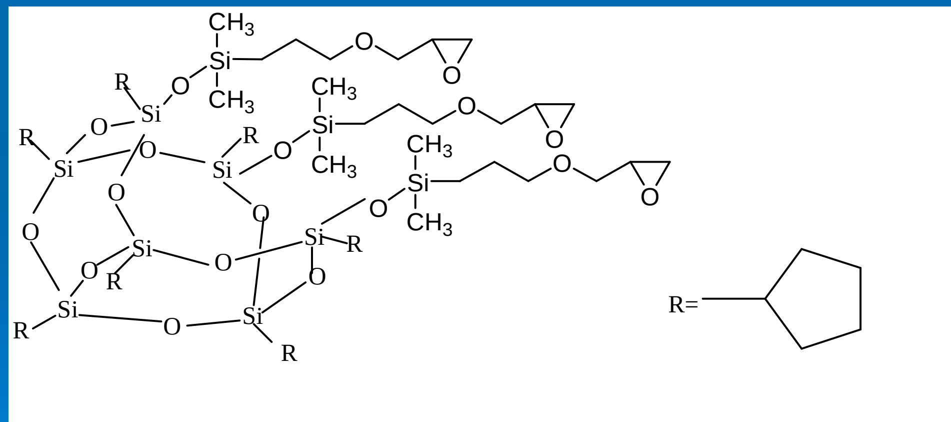


Montmorillonite structure



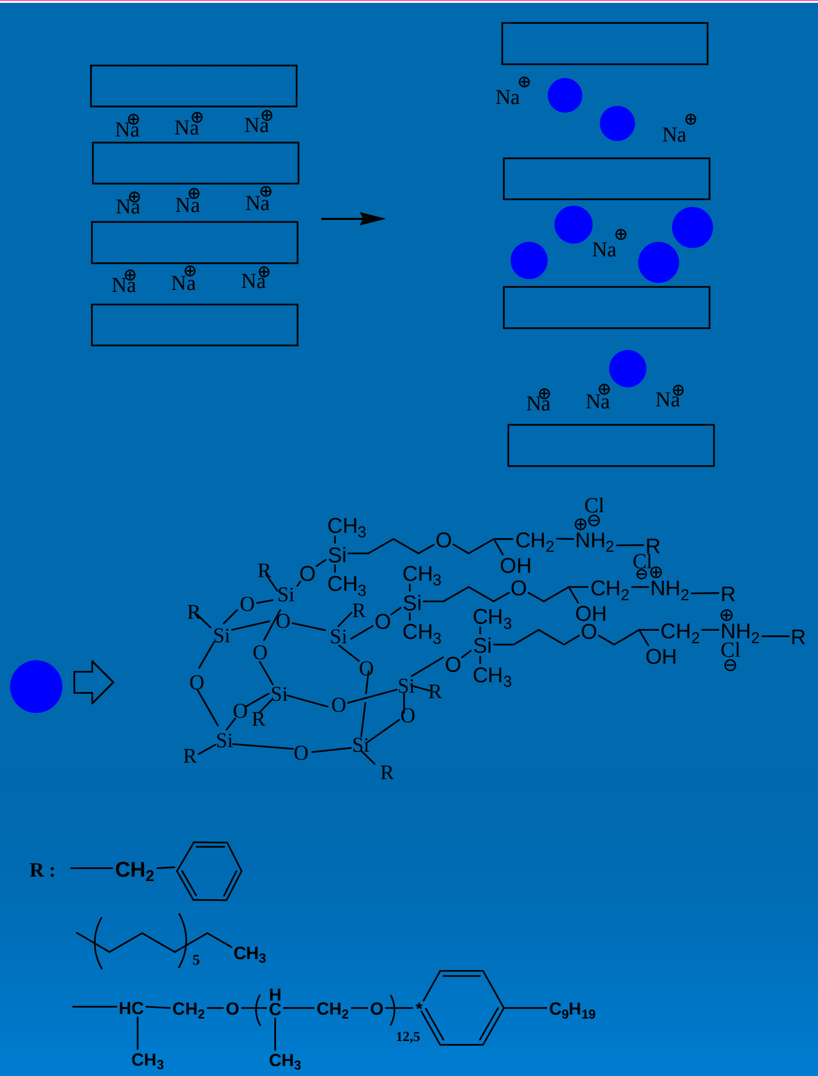
2. Polyhedral oligomeric silsesquioxane (POSS)



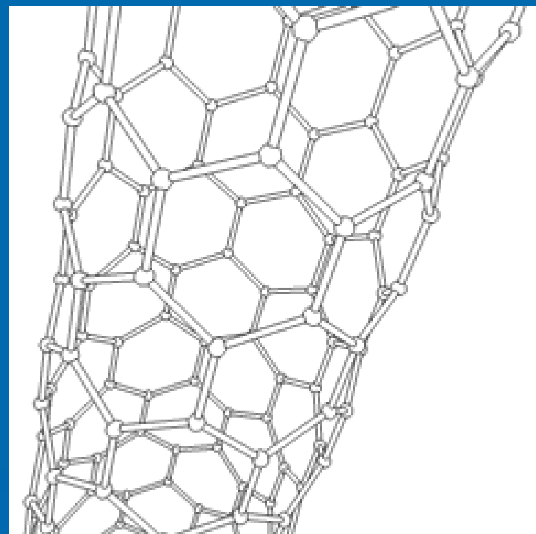


$(RSiO_{1.5})_n$

3. Montmorillonite intercalated with POSS

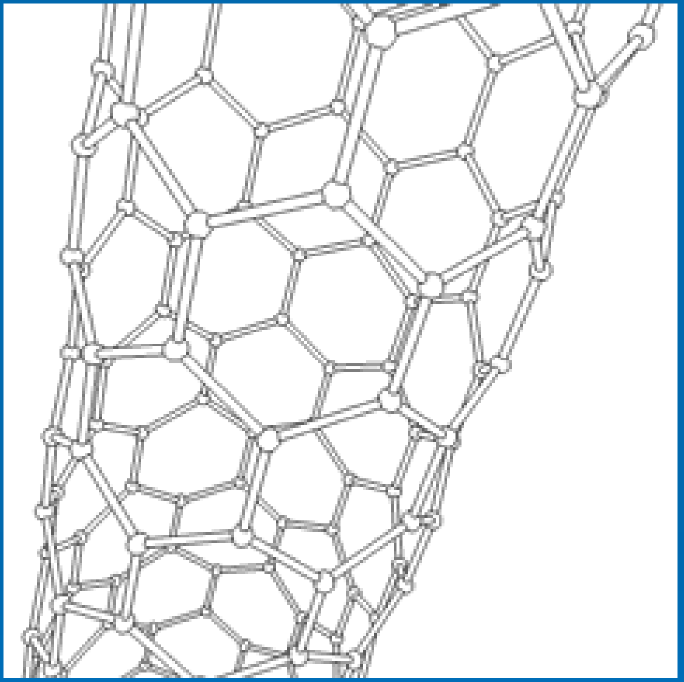


4. Carbon nanotubes



S. A. Gârea, F. Constantin, G. Voicu, H. Iovu, New nanocomposites based on epoxy resin and modified montmorillonite with polyhedral oligomeric silsesquioxane-amine compounds, **Materiale Plastice, 45, no. 4, 2008**

Synthesis and characterization of new nanocomposites based on epoxy resins and multiwalled carbon nanotubes (MWNT)



C. Damian, A. Pandele, C. Andronescu, A. Ghebaur, S. Garea, H. Iovu, Fullerenes, Nanostructures and Carbon Nanotubes, 2009, accepted.

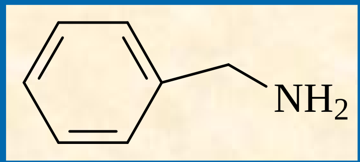
Objectives

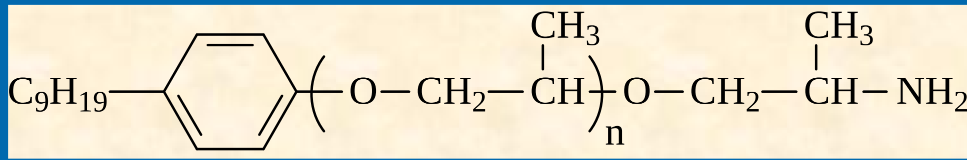
- MWNT oxidation : MWNT-COOH
- MWNT-COOH functionalization with aromatic monoamines
- Characterization of modified MWNT by: FT-IR, Raman, XPS, TEM,TGA
- Synthesis of new composites based on epoxy resin reinforced with modified MWNT
- Characterization of the new composites by: DSC, FT-IR, DMA, SEM

Materials

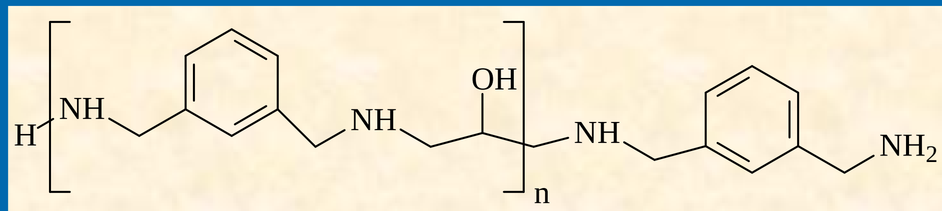
Polymer matrix: DGEBA

Modifiers: benzylamine (BA) and Surfonamine B100





Crosslinking agent :
Poly (m-xylyenediamine-alt-epichlorhydrin), diamine terminated (PXDED)



MWNT functionalization process

Scheme 2.

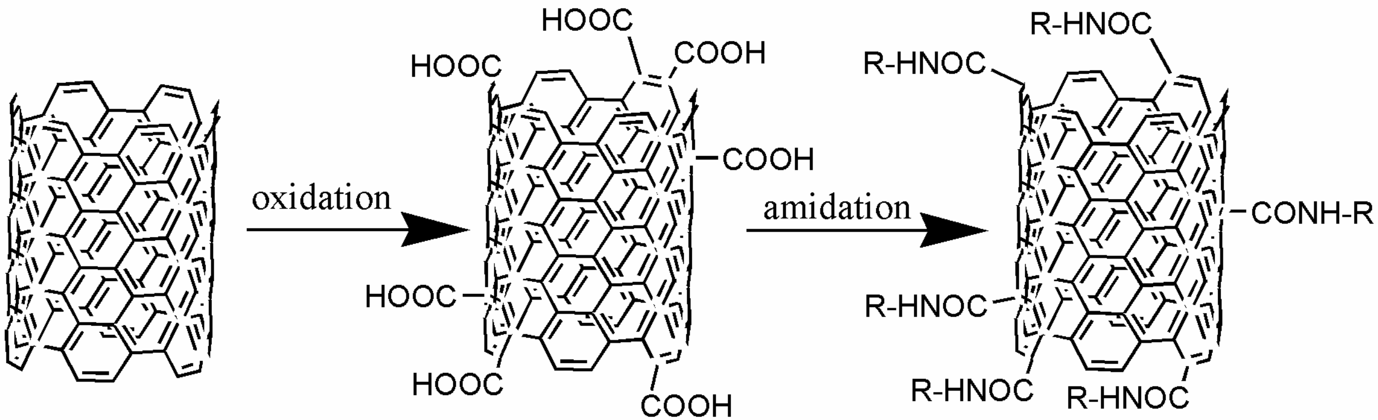
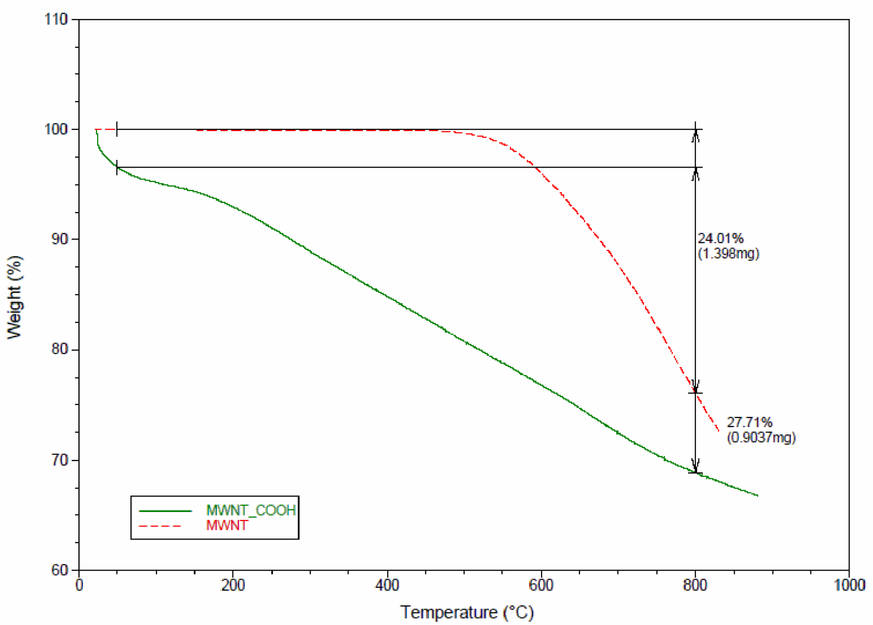


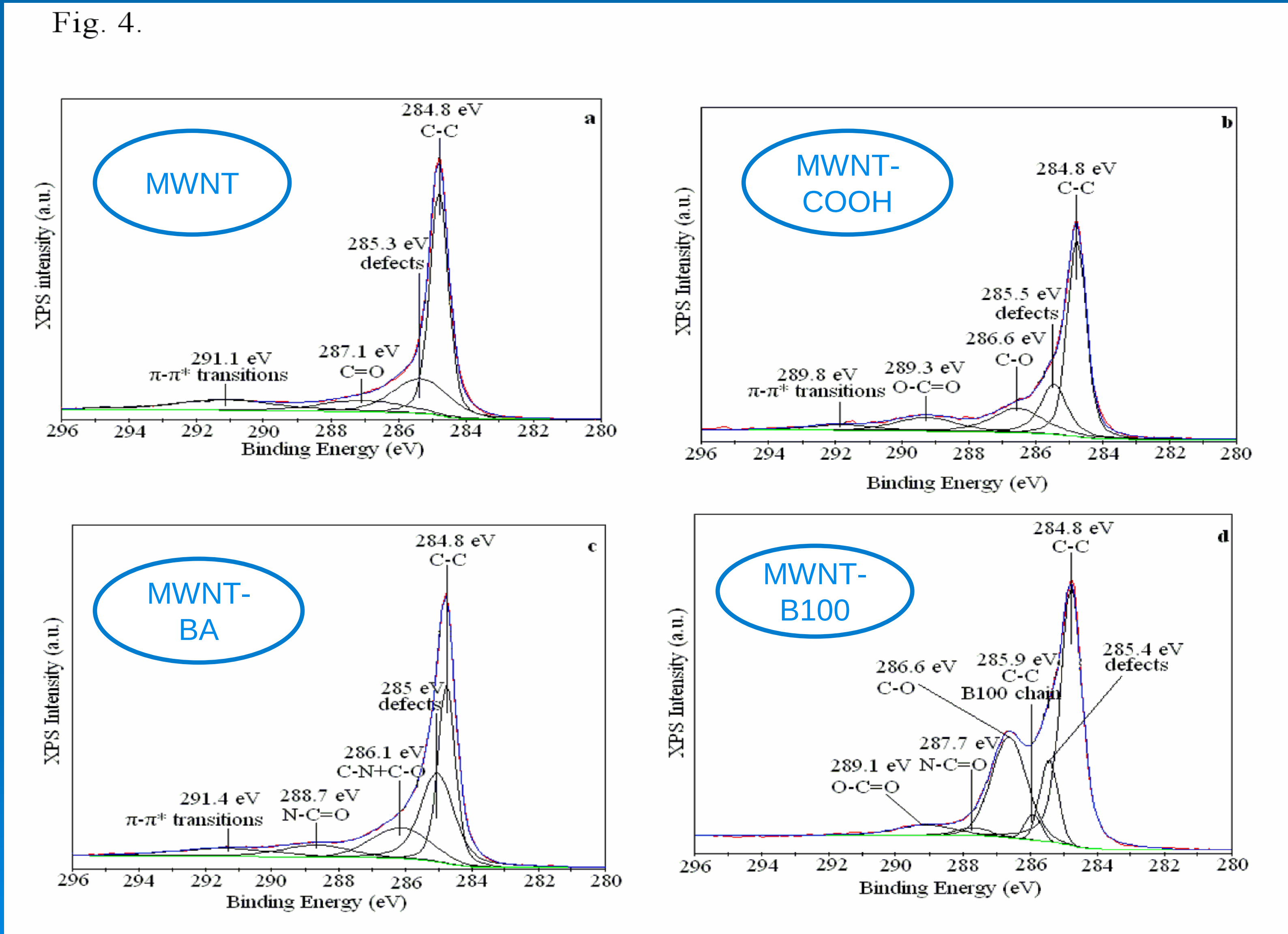
Fig. 2.



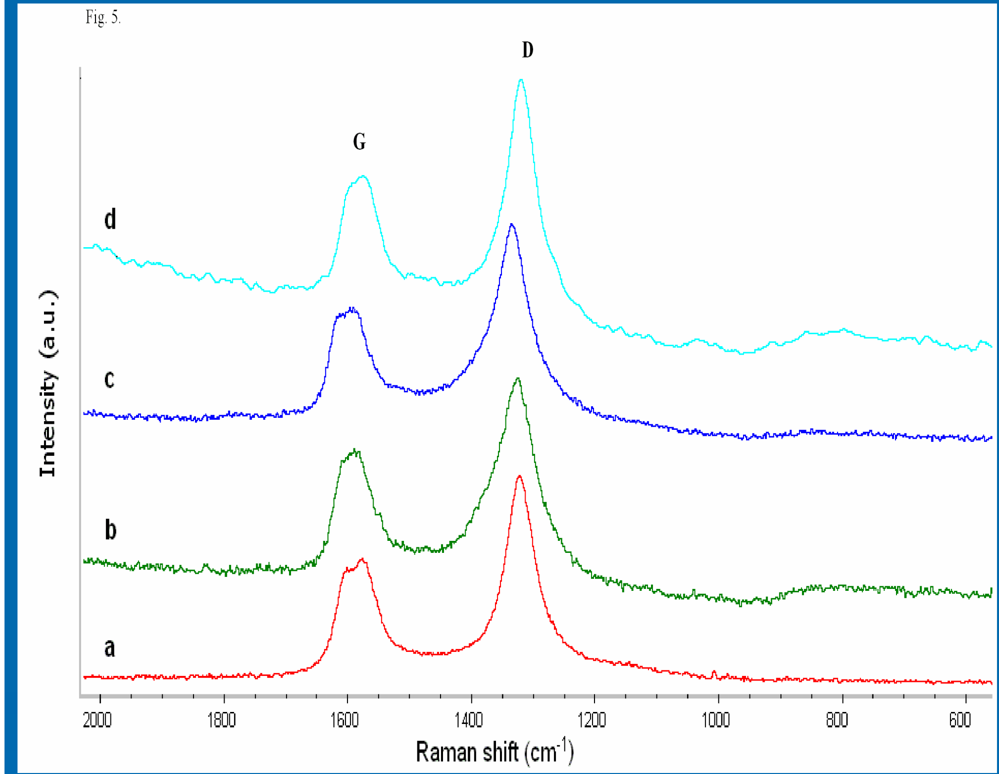
The composition of MWNT, MWNT-COOH, MWNT-B100 and MWNT-BA from XPS analysis

CNTs	C 1s (%)	O 1s (%)	N 1s (%)
MWNT	99.3	0.7	-
MWNT-COOH	83.8	16.2	-
MWNT-B100	81.9	16.9	1.2
MWNT-BA	88.3	9.7	2.0

XPS carbon-deconvolution spectra



Dispersive Raman spectra



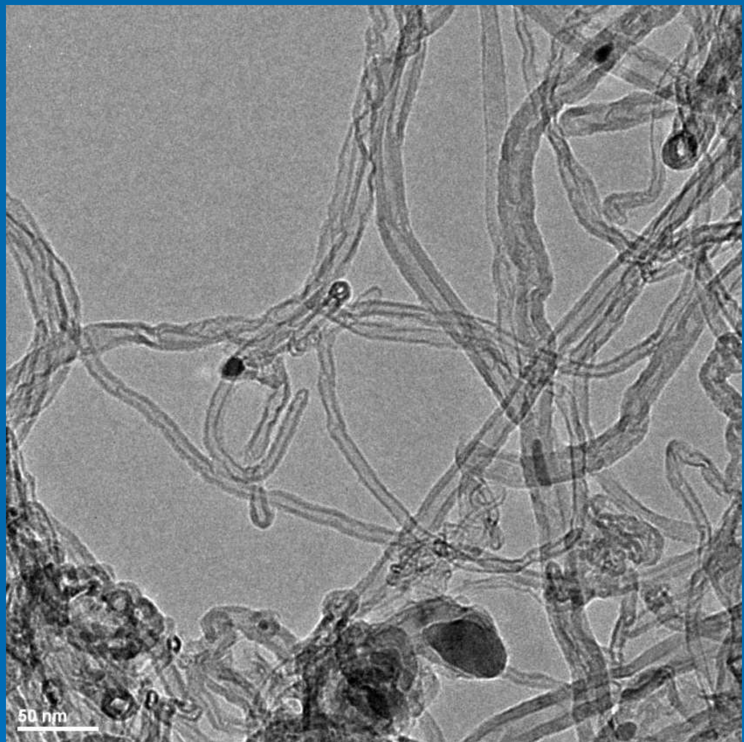
D – 1320 cm^{-1}
G- 1580 cm^{-1}

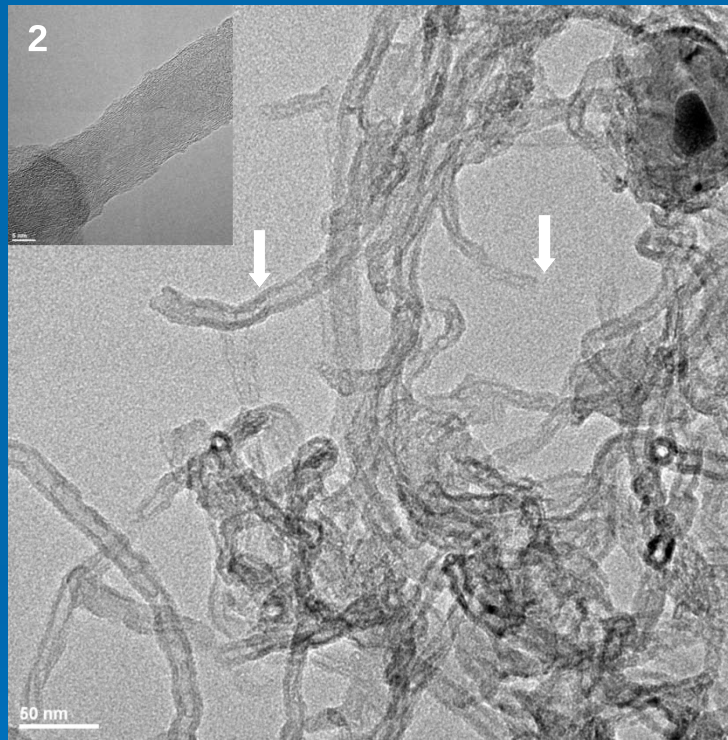
I_D/I_G

Raman intensities for the characteristic D and G bands

CNTs	I_D	X_D (cm^{-1})	I_G	X_G (cm^{-1})	I_D/I_G
MWNT	58.86	1323	34.75	1581	1.69
MWNT-COOH	14.28	1319	8.15	1577	1.75
MWNT-BA	40.04	1338	22.49	1593	1.78
MWNT-B100	12.34	1319	6.41	1577	1.92

TEM analysis

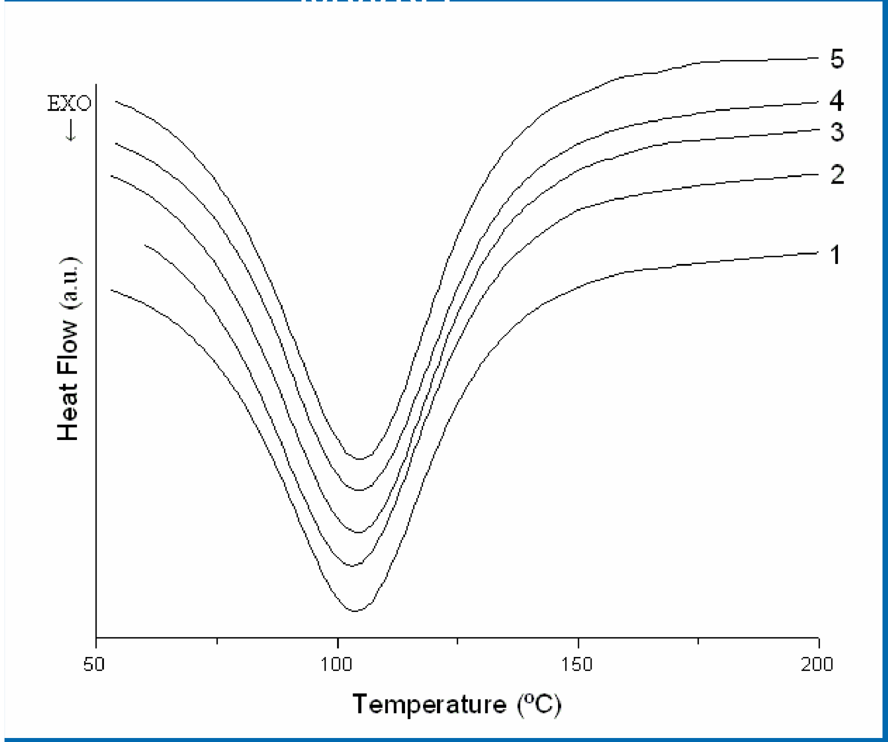




MWNT

MWNT-COOH

Synthesis of nanocomposites based on functionalized MWNT



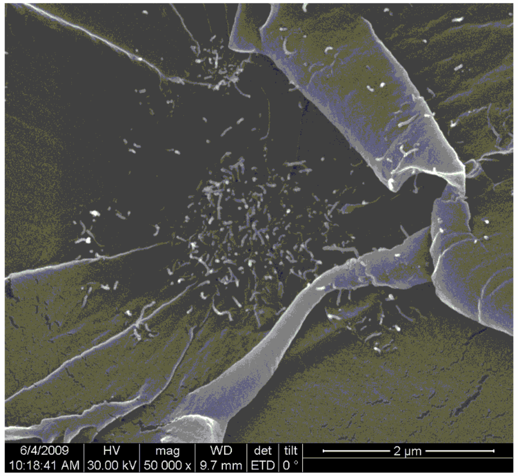
Composite	ΔH, J/g
DGEBA/PXDED	424.7
DGEBA/PXDED/MWNT	391.7
DGEBA/PXDED/MWNT-COOH	426.1
DGEBA/PXDED/MWNT-BA	413.8
DGEBA/PXDED/MWNT-B100	410.6

Composite	Tg (°C)
DGEBA/PXDED	127.8
DGEBA/PXDED/MWNT	126.4
DGEBA/PXDED/MWNT-COOH	125.4
DGEBA /PXDED/MWNT-BA	124.1
DGEBA/PXDED/MW-B100	126.1

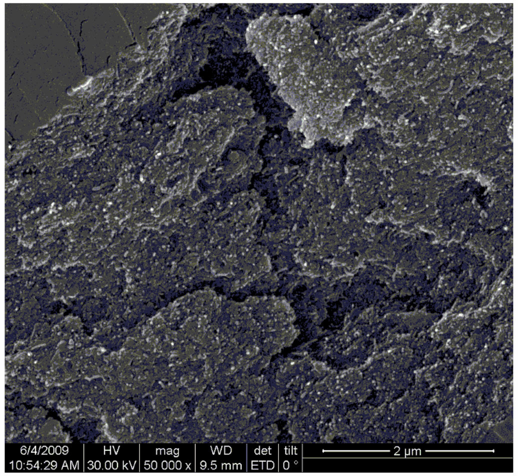
1-DGEBA/PXDED
2-DGEBA/MWNT/PXDED
3-DEGEBA/MWNT-COOH/PXDED
4-DGEBA/MWNT-BA/PXDED
5-DGEBA/MWNT-B100/PXDED

SEM Analysis

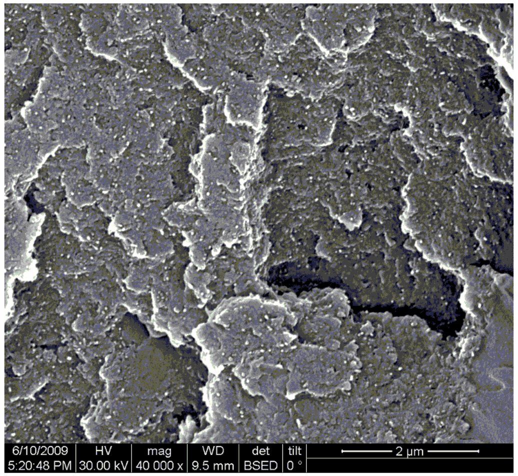
Fig. 8.



a)



b)



c)

a) DGEBA/MWNT/PXDED
b) DGEBA/MWNT-COOH/PXDED
c) DGEBA/MWNT-B100/PXDED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MATERIALS GROUP

ADVANCED POLYMER MATERIALS GROUP

1. Laboratory for nanocomposites synthesis

2. Laboratory for mechanical testing (tensile, compression, bending, impact strength)

3. Laboratory for advanced characterization of polymer materials (XPS, DMA, DETA, DSC Linseis, DSC Netzsch, GPC, TGA-MS)

4. Laboratory for advanced spectroscopic characterization (FT Raman, Dispersive Raman, FTIR Bruker, FTIR Shimadzu)

X-Ray Photoelectron Spectrometer K-Alpha (Thermo Scientific USA)

- SURFACE ANALYSIS -

Dispersive Raman Spectrometer – DXR Raman Microscope
(Thermo Scientific USA)

FT Raman module (Bruker) from DSC-FTIR-Raman assembly