Progetto FIRB **“Tecnologie per la manipolazione su scala nanometrica dei materiali e loro applicazione biomedica”**

U.O. dell’UNIVERSITA’ di CATANIA –
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III ANNO

Riassunto della attività di ricerca

attività di screening degli anni precedenti:

. diversi materiali (PET e PTFE commerciali (GoodFellow), PET rivestito di carbonio pirolitico),

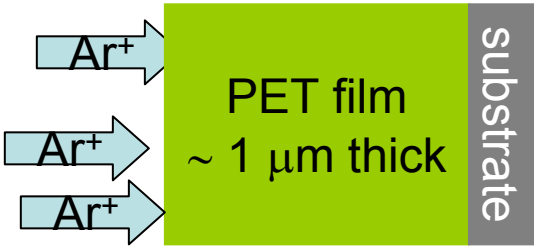
. diversi trattamenti di irradiazione (ioni Ar^+ o He^+, plasmi freddi di O_2 o Ar), a condizioni differenti di modifica (energie ioniche di 500 eV, 25 keV e 50 keV, fluenze ioniche nel range di 10^{14}-10^{16} ioni/cm^2, tempi di plasma da 10 a 60 secondi) e invecchiamento dopo la stessa (*aging* in aria o acqua),

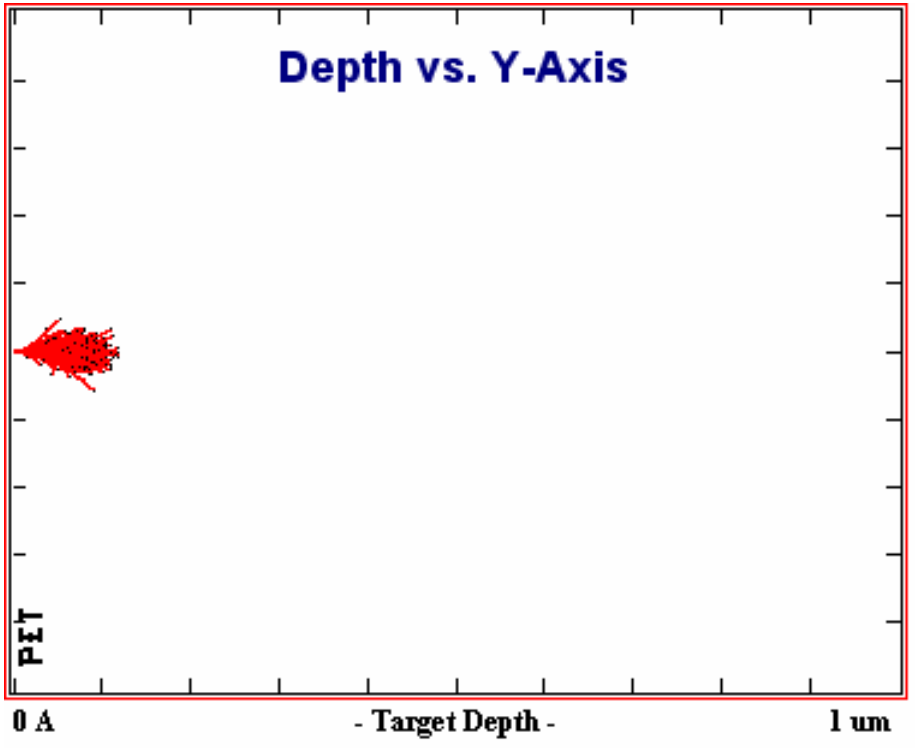
III anno:

materiale: film sottili di PET depositati su substrati ultrapiatti di silicio (wafer monolucidi e monocristallini <100>) mediante la tecnica di spin coating (60 sec a 3000 rpm) da soluzione (2% wt) 90/10 cloroformio/esafluoropropanolo.

trattamento di funzionalizzazione di superfici: irradiazione con ioni Ar^+ 50 keV alla fluenza di $1x10^{15}$ ioni/cm^2.

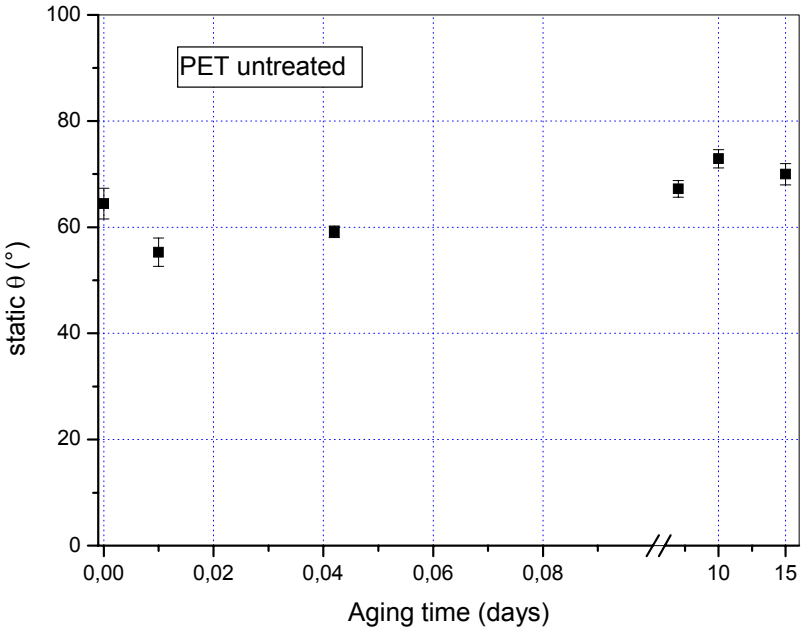
Nanostructured films

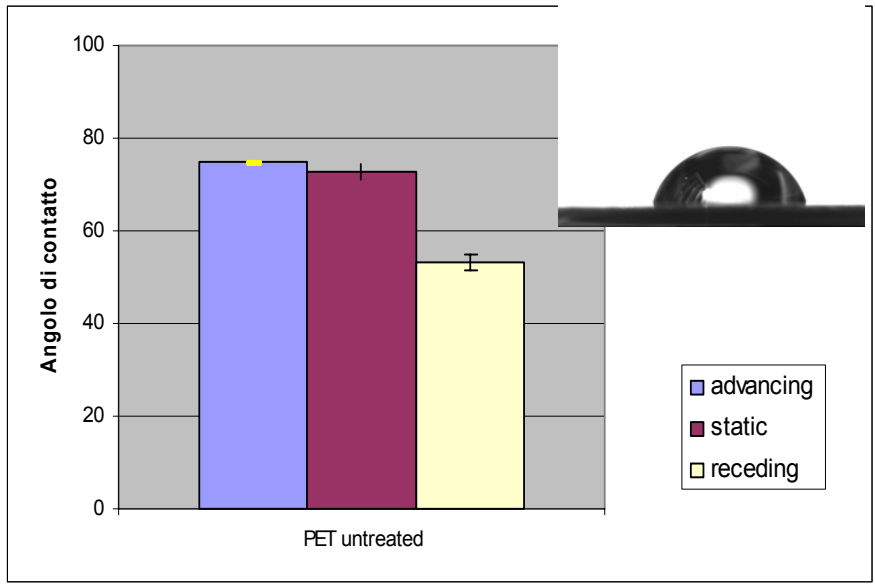




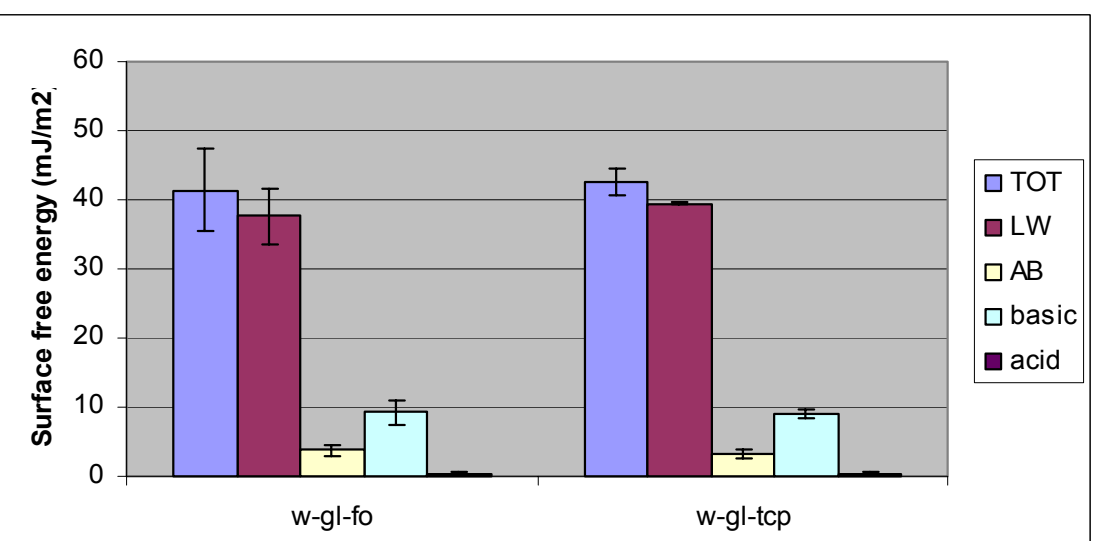
SRIM simulation
(Rp=70±20 nm)

Caratterizzazione dei processi di invecchiamento e stabilizzazione dalla deposizione dei film





Surface Free Energy



W=Lifshitz van der Waals
B= Lewis acid-base

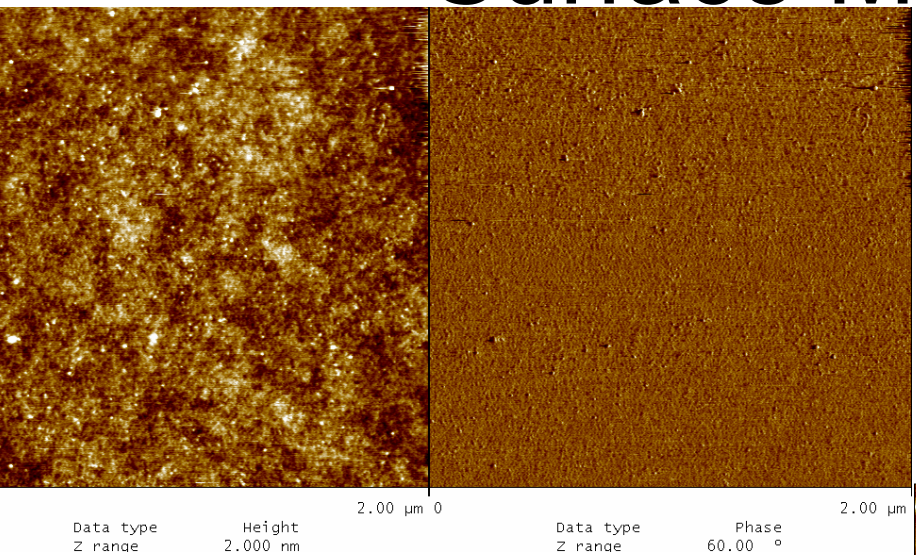
$$\gamma^{TOT} = \gamma^{LW} + \gamma^{AB}$$

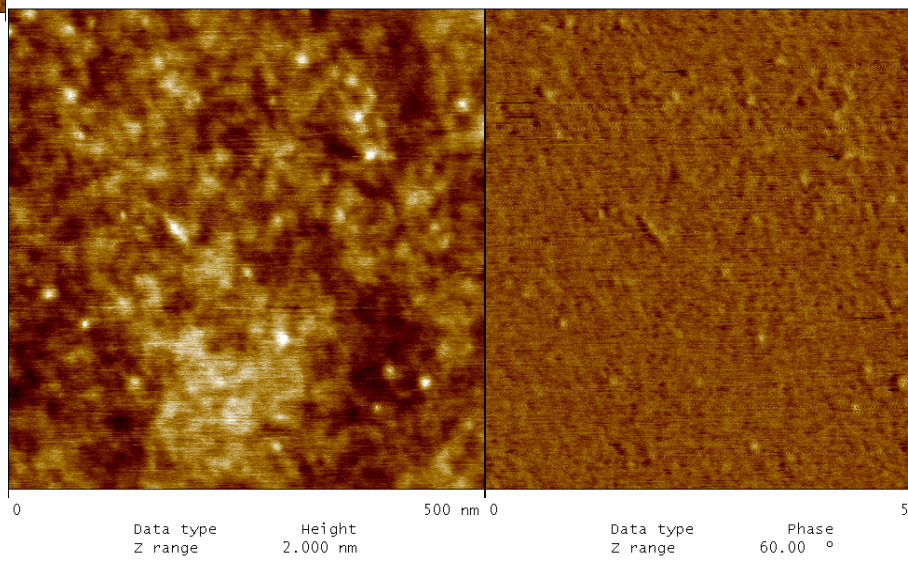
$$\gamma^{AB} = 2\sqrt{\gamma^{acid} \cdot \gamma^{basic}}$$

Good van Oss'approach

$$\gamma^{TOT}(1+\cos\theta) = 2\left(\sqrt{\gamma_s^{LW} \cdot \gamma_l^{LW}} + \sqrt{\gamma_s^{acid} \cdot \gamma_l^{base}} + \sqrt{\gamma_s^{base} \cdot \gamma_l^{acid}}\right.$$

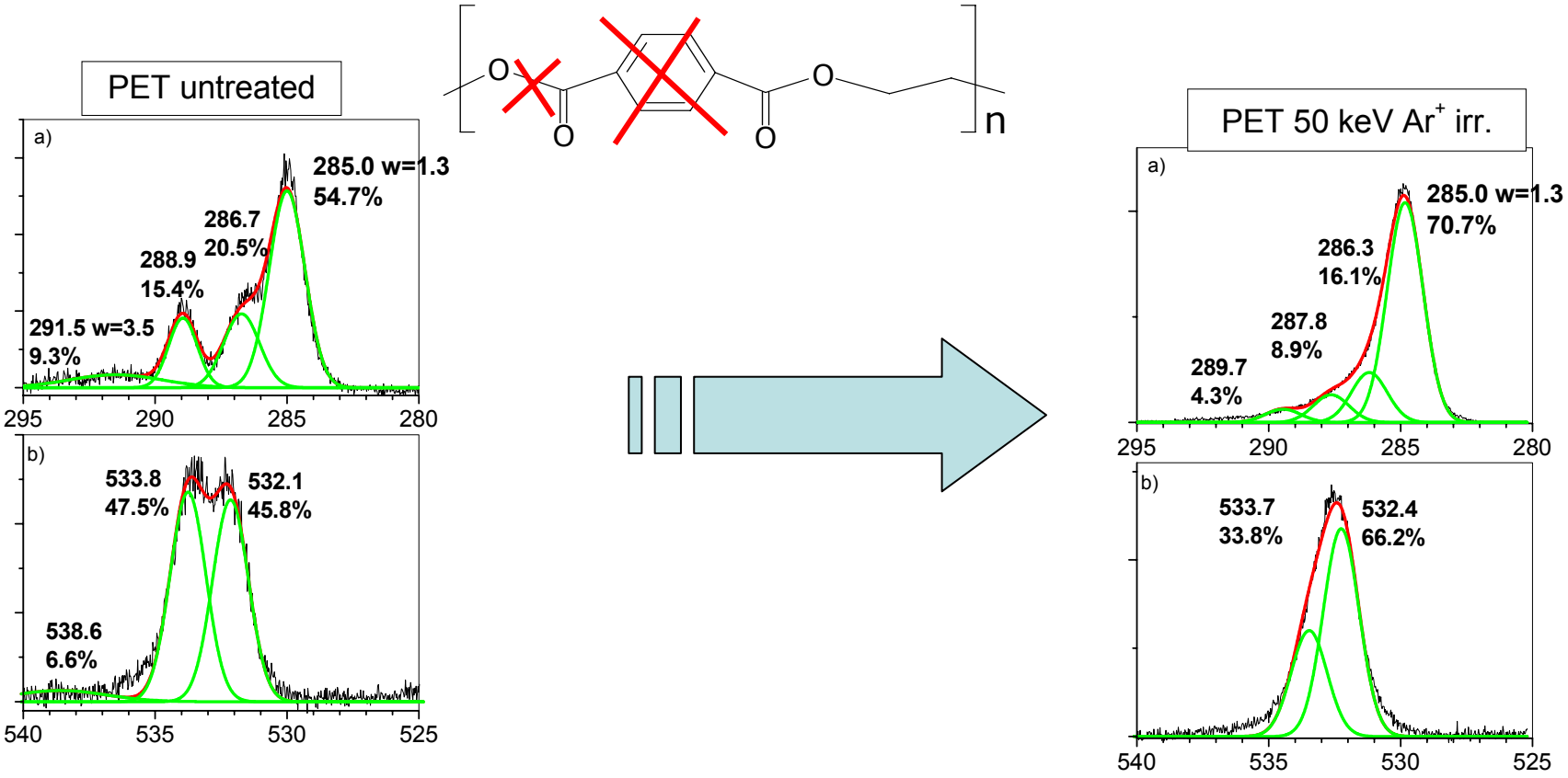
Surface Morphology





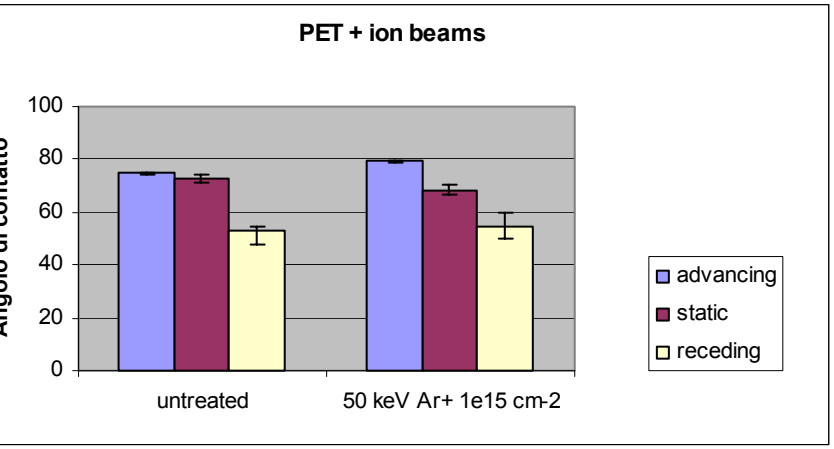
	R_{rms} (nm)	R_a (nm)	R_{max} (nm)
PET non modificato	0.259±0.006	0.200±0.006	4.249±0.300

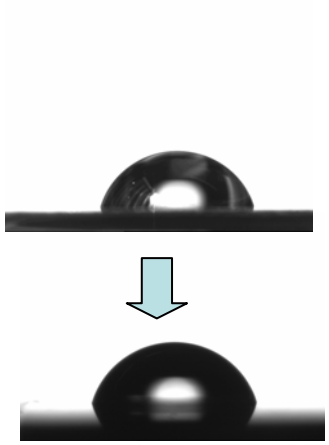
Modification of PET by 50 keV Ar^+ irradiation (10^{15} cm^{-2})

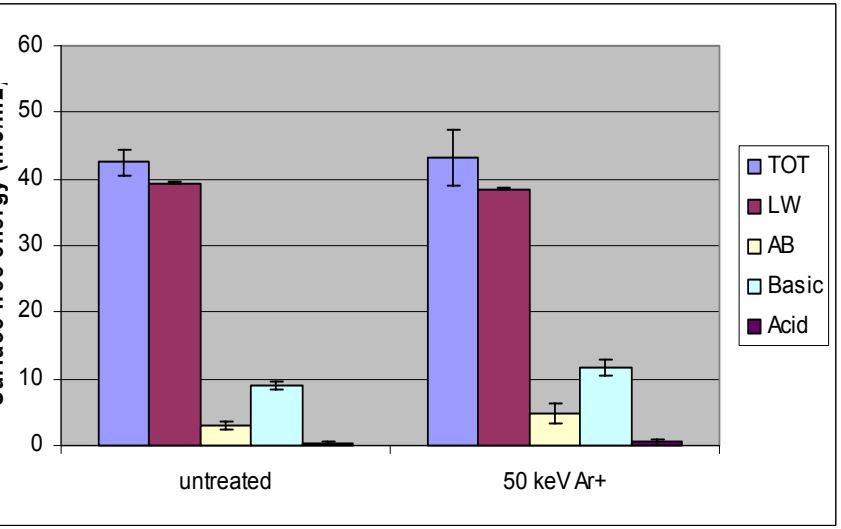


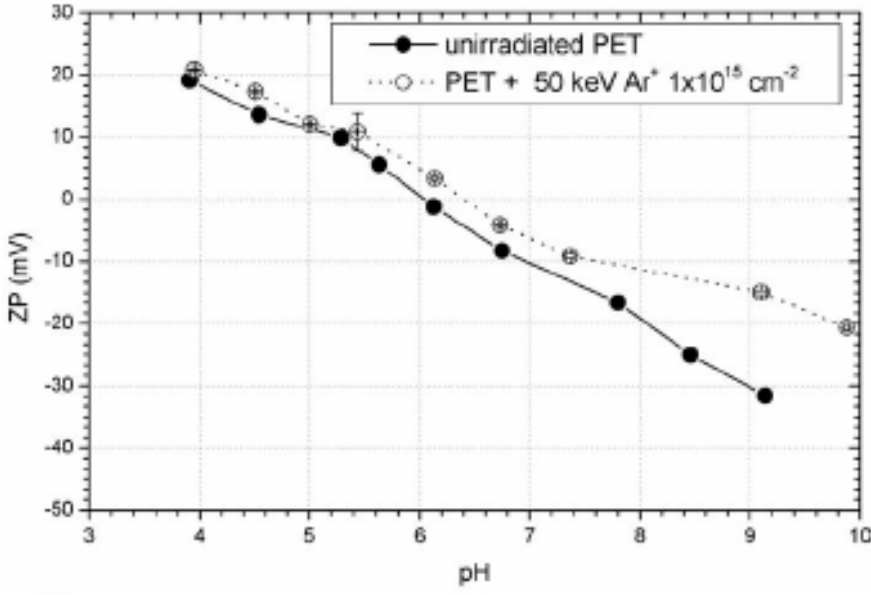
PET	O 1s at. %	C 1s at. %	O/C
untreated	31.8	68.1	0.5
Ar^+ irr.	15.4	84.6	0.2

Surface free energy and charge modification by irradiation







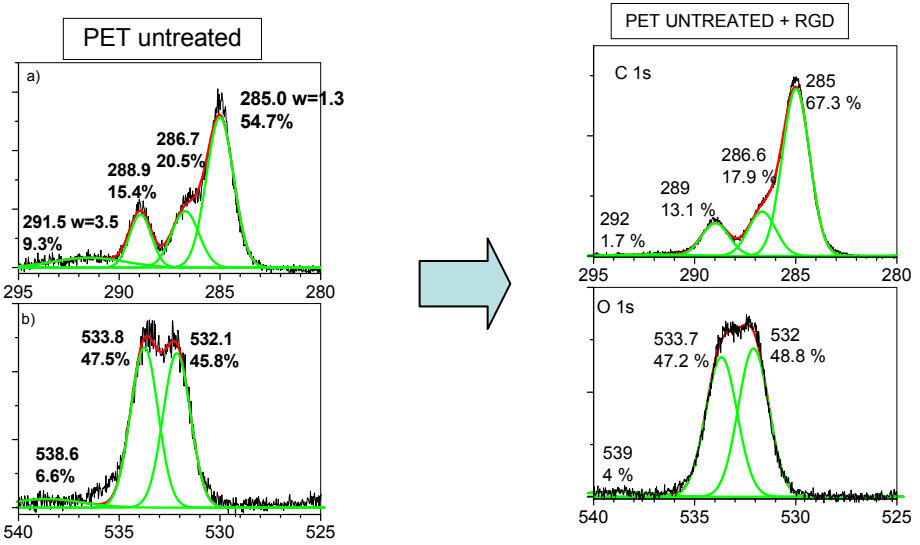


RGD-immobilized surfaces

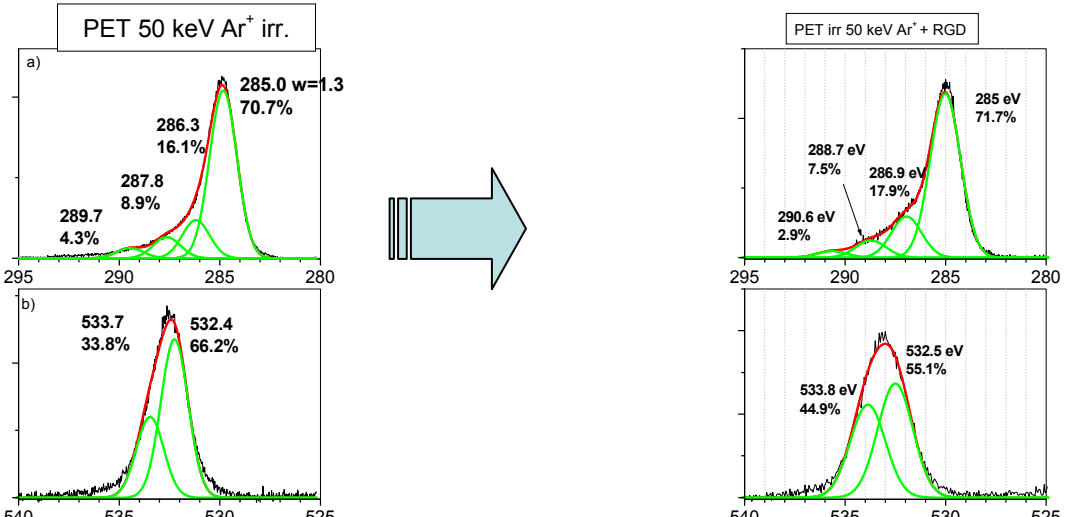
PET	O 1s at. %	C 1s at. %	N 1s %	O/C
Untreated	31.8	68.1		0.5
Untreated +RGD	25.6	60.7	1.1	0.4
Ar^+ irr	15.4	84.6		0.2
Ar^+ irr + RGD	15.1	82.4	2.6	0.2

RGD-immobilized surfaces

Untreated PET



Irradiated PET

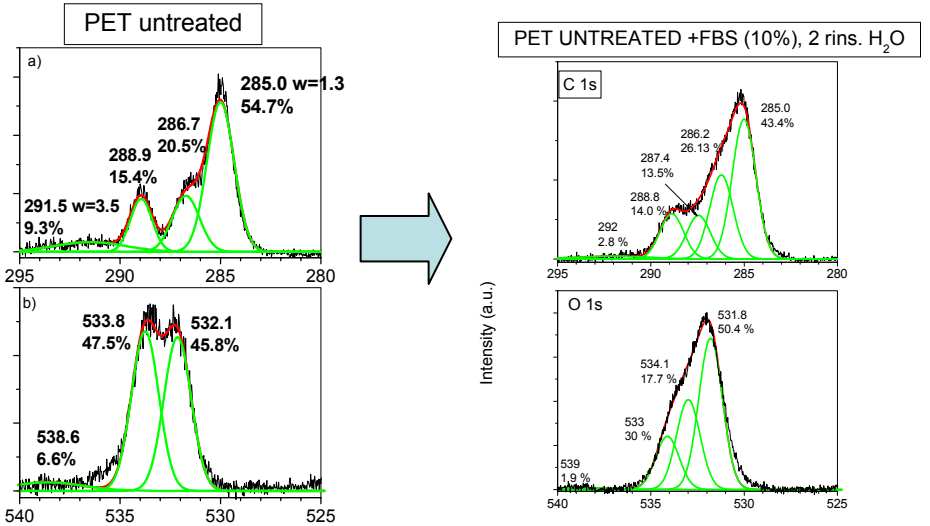


FBS-immobilized surfaces

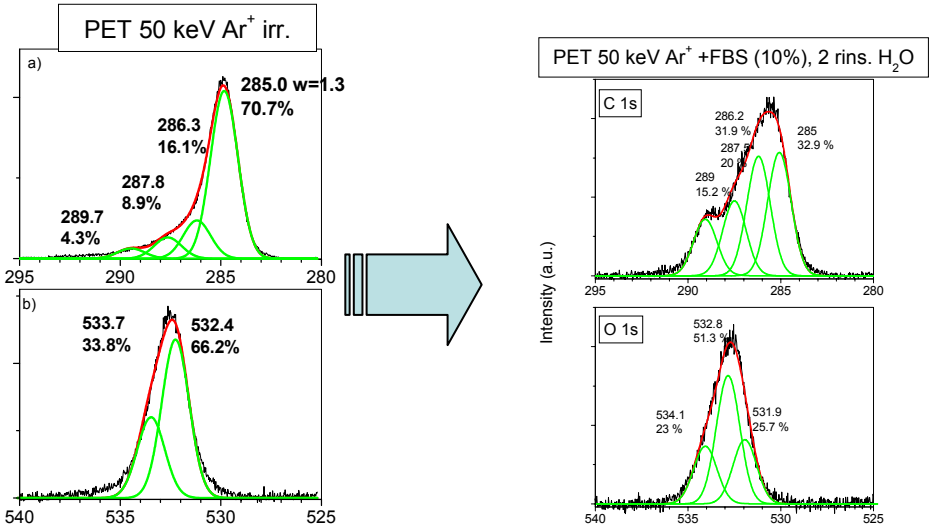
PET	O 1s at. %	C 1s at. %	N 1s %	O/C
untreated	31.8	68.1		0.5
Untreated + FBS	23.9	65.0	11.1	0.4
Ar^+ irr	15.4	84.6		0.2
Ar^+ irr + FBS	19.0	69.5	12.4	0.3

FBS-immobilized surfaces

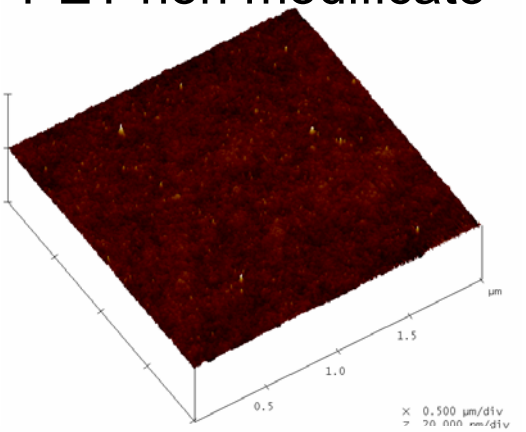
Untreated PET



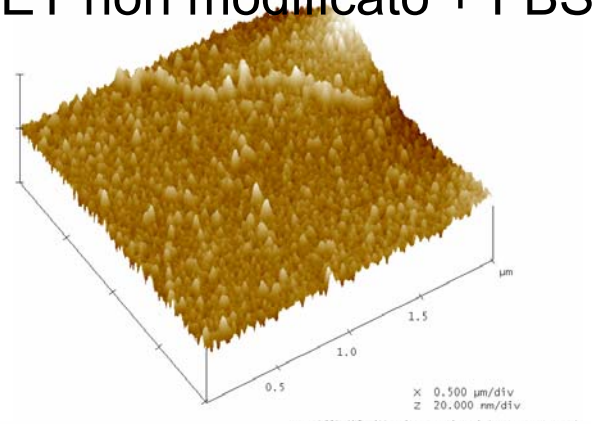
Irradiated PET



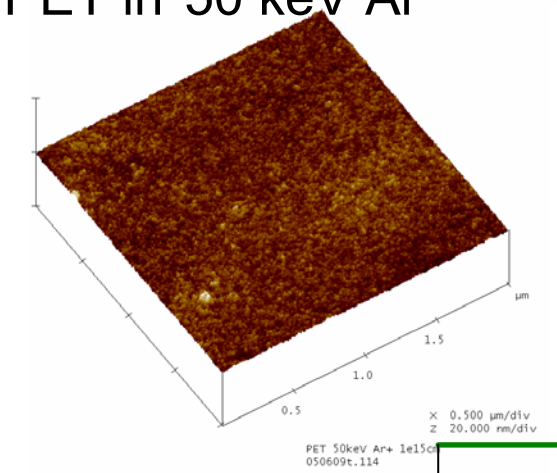
PET non modificato



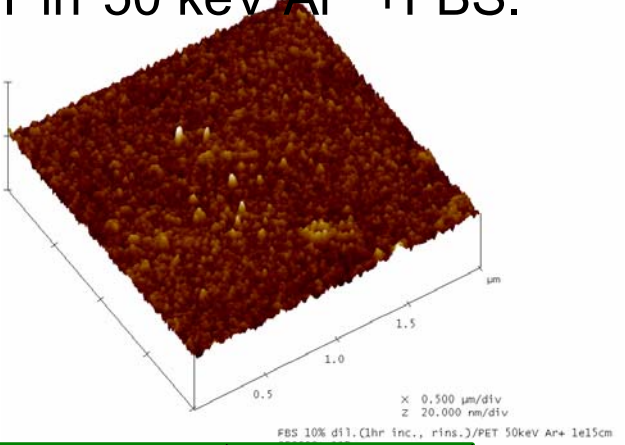
PET non modificato + FBS



PET irr 50 keV Ar^+



PET irr 50 keV Ar^+ +FBS.



	R_{rms} (nm)	R_a (nm)	R_{max} (nm)
PET non modificato	0.259±0.006	0.200±0.006	4.249±0.300
PET non modificato+ FBS	1.500±0.370	1.126±0.269	12.19±4.51
PET irradiato	0.250±0.009	0.198±0.006	2.256±0.353
PET irradiato + FBS	0.634±0.034	0.494±0.020	6.242±1.027

Campioni per test biologici

i) UO Napoli (Prof. Barbarisi)

A = 6 pz. (3x3) cm2 PET irradiato
B = 6 pz. (3x3) cm2 pcs. PET non modificato
C = 7 pz. (1x1) cm2 pcs. PET irradiato
D = 6 pz. (1x1) cm2 pcs. PET non modificato
E = 6 pz. (1x1) cm2 + (0.3x0.3) cm2 pcs. PET irradiato + RGD
F = 6 pz. (1x1) cm2 + (0.3x0.3) cm2 pcs. PET non modificato +RGD
G = 7 pz. (1x1) cm2 + (0.3x0.3) cm2 pcs. PET irradiato + FBS
H = 6 pz. (3x3) cm2 + (0.3x0.3) cm2 pcs. PET non modificato+FBS

UO Siena (Prof. Ziche)

A = 3 pz. (3x3) cm2 PET irradiato
B = 3pz. (3x3) cm2 PET non modificato
C = 3 pz. (2x2) cm2 PET irradiato
D = 3pz. (2x2) cm2 PET non modificato
E = 3pz. (2x2) cm2 PET irradiato + RGD
F = 2 pz. (2x2) cm2 PET non modificato+ RGD
G = 3 pz. (2x2) cm2 PET irradiato + FBS
H = 3pz. (2x2) cm2 PET non modificato + FBS

UO Padova (Prof. Abatangelo)

A = 6 pz. (3x3) cm2 PET irradiato
B = 12 pz. (3x3) cm2 PET non modificato
C = 9 pz. (1x1) cm2 PET irradiato
D = 9 pz. (1x1) cm2 PET non modificato