DIN - DEPARTMENT OF INDUSTRIAL ENGINEERING

PhD Course in Mechanics and Advanced Engineering Sciences (DIMSAI)

PHD STUDENT POSTER - AY *2016/2017* **Curriculum number *3*** **Cycle *32nd***

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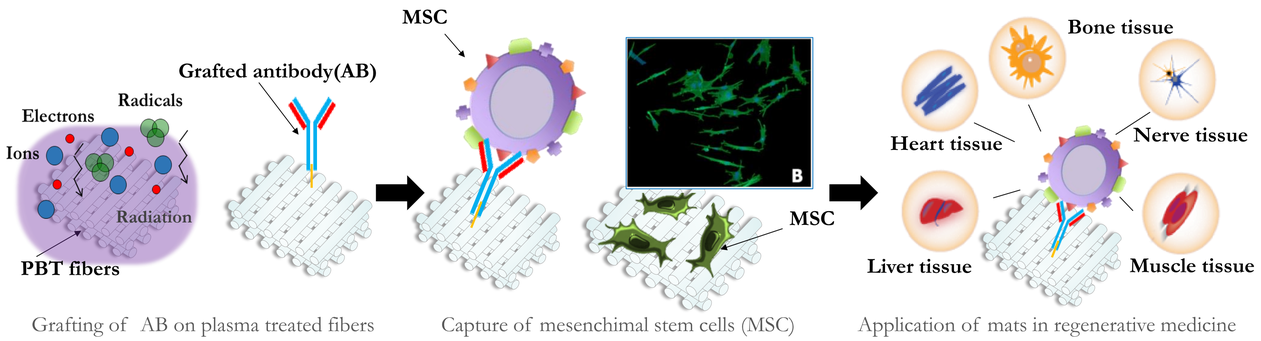
PHYSICAL AND ENGINEERING DESIGN OF OPTIMIZED PROCESSES ASSISTED BY ATMOSPHERIC NON-EQUILIBRIUM PLASMAS FOR SURFACE MODIFICATION OF POLYMERIC MATERIALS

GRAPHICAL ABSTRACT



Atmospheric non-equilibrium plasma treatment of PBT fibers to promote the grafting of antiCD10 antibody (AB), suitable for the selective capture of mesenchimal stem cells.

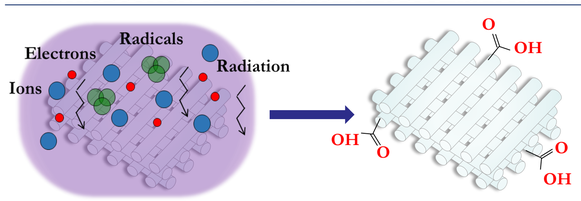
SUMMARY

The development of active polymeric membranes suitable for the **grafting of enzyme, AB and biomolecules** has risen a great interest in biomedical fields. Traditional functionalization processes involving the use of chemical methods are usually time-consuming and toxic, therefore alternative solutions are required. In this work, double step **plasma assisted functionalization** is proposed as an **eco-friendly and easy handling approach for the surface modification of polymeric membranes**. In the first step polybutylene terephthalate (PBT) fiber mats are plasma functionalized by means of an open air dielectric barrier discharge (DBD) plasma source to introduce carboxylic groups on the membranes surface; in the second step a diaminic linker is bonded to carboxylic groups promoting the conjugation of the AB antiCD10 through their constant region on fibers. The achieved results confirm the effective **grafting of antiCD10** molecules on plasma treated fibers and highlight the **AB suitability for the selective capture of MSCs**. Further investigations are on going to verify **the biocompatibility and selectivity of PBT conjugated mats**.

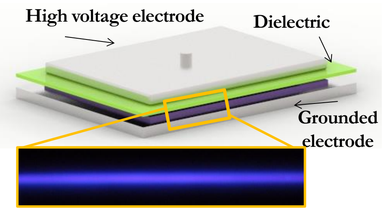
Dolci, L. S., et al. "Antibody immobilization on poly (L-lactic acid) nanofibers advantageously carried out by means of a non-equilibrium atmospheric plasma process." Journal of Physics D: Applied Physics 49.27 (2016): 274003.

MATERIALS AND METHODS

STEP 1
INTRODUCTION OF –COOH MOIETIES BY PLASMA TREATMENT

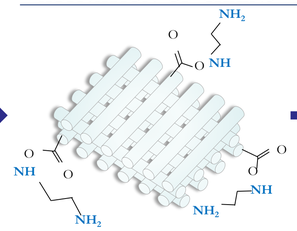


Open air DBD plasma source

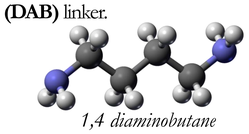


Operating conditions	
Voltage	13.5 kV
Frequency	500 Hz
Treatment time	30 s

STEP 2
ACTIVATION OF CHAINS

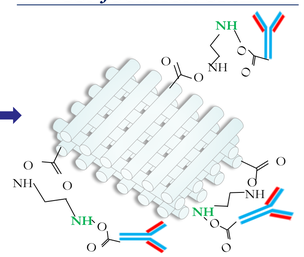


EDC/NHS promotes the activation of –COOH chains and the covalent bonding of **1,4 diaminobutane (DAB)** linker.

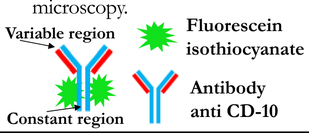


1,4 diaminobutane

STEP 3
CONJUGATION OF AB

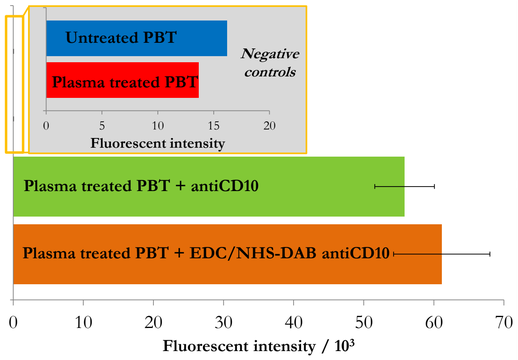


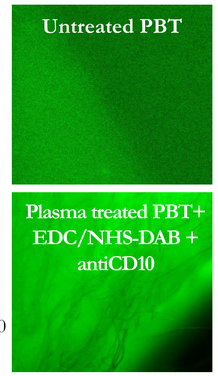
The grafted antiCD10 labelled with **fluorescent dyes** can be detected by fluorescence microscopy.



RESULTS

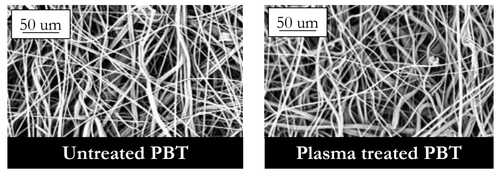
FLUORESCENCE MICROSCOPY





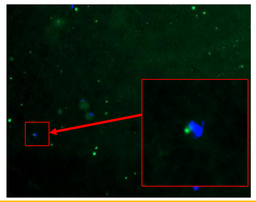
AB **antiCD10 is** successfully immobilized on plasma treated fibers. The employment of **diaminc linker promotes the grafting** of AB through its constant region making the variable region is available for MSC capture.

SEM ANALYSIS OF PBT FIBERS



Plasma treatment does not affect the morphology of the membranes.

BIOLOGICAL TEST



Preliminary biological results on PLLA show the co-localization of MSC (blue) and AB (green). Further experiments are still on-going on PBT

CONCLUSIONS

Plasma treatment of polymeric fibers is able to promote the covalent immobilization of antiCD10. High quantity of AB is grafted on plasma functionalized PBT and the employment of the diaminic linker allows the bonding through the constant region . Preliminary biological assays (carried out so far on PLLA) show the co-localization of AB and MSC. Further investigations are going on to asses the selectivity of treated PBT membranes for capture mesenchimal stem cells.

ALMA MATER STUDIORUM – UNIVERSITÀ DI BOLOGNA

IL PRESENTE MATERIALE È RISERVATO AL PERSONALE DELL'UNIVERSITÀ DI BOLOGNA E NON PUÒ ESSERE UTILIZZATO AI TERMINI DI LEGGE DA ALTRE PERSONE O PER FINI NON ISTITUZIONALI