Low temperature plasma treatment of PA and PP for release of a model drug

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22nd IFATCC INTERNATIONAL CONGRESS
Italy, Stresa, May 5-7, 2010

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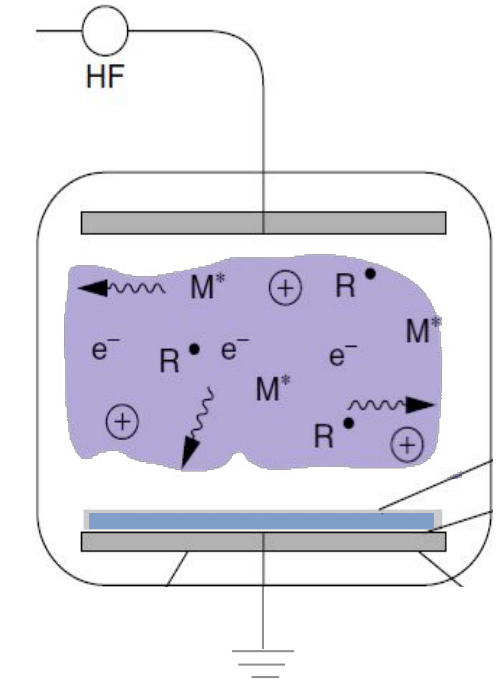
INTRODUCTION

Surface Treatment by Plasma



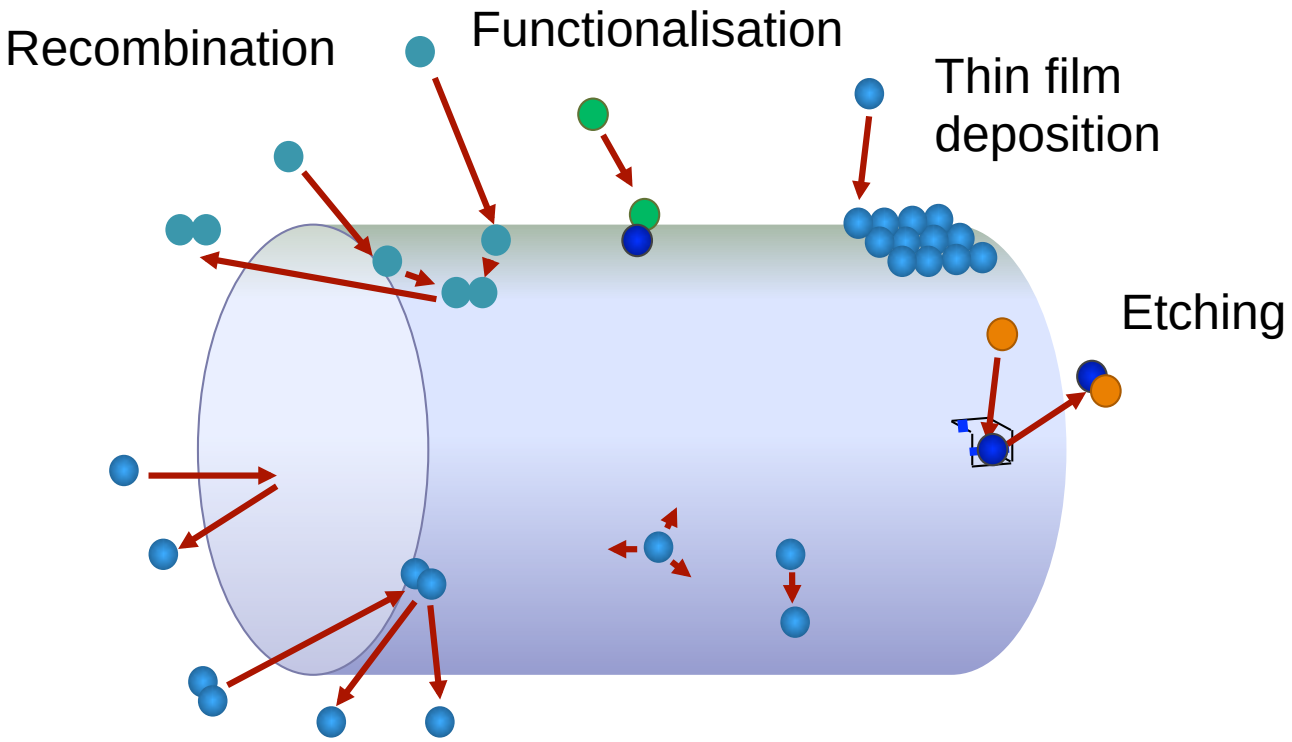
R• radicals

e⁻ electrons

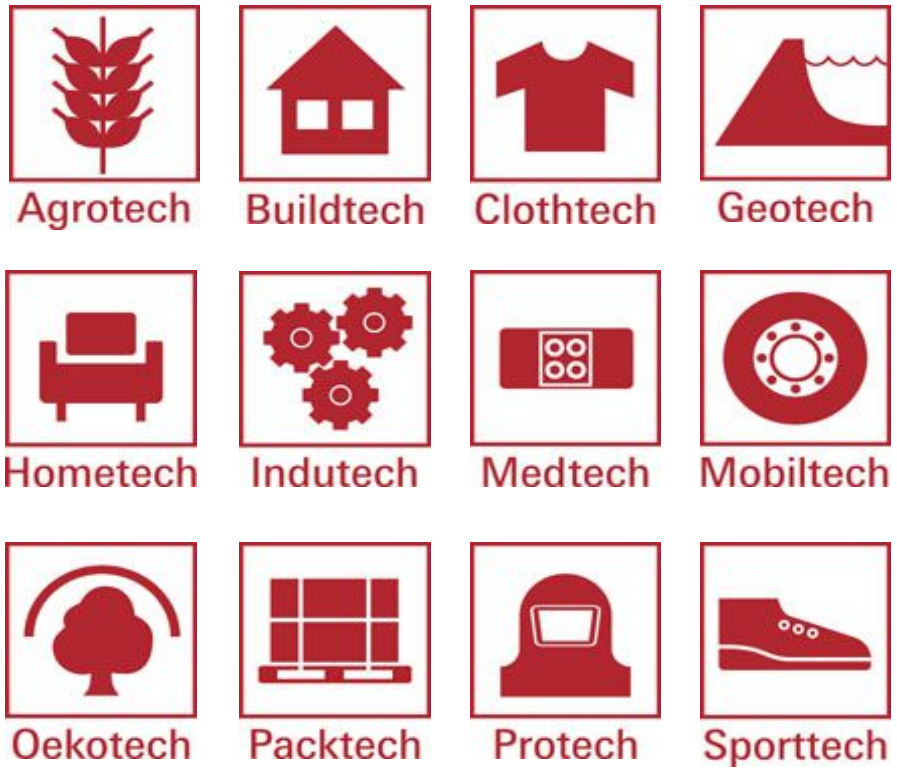
⊕ ions

M* electronic excited particles

UV-radiation



Medical textiles



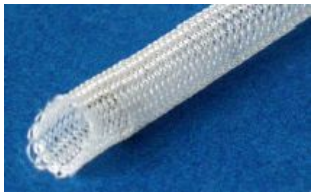
- Products used for medical and pharmaceutical applications. Mainly used for first aid and clinical and hygienical aims.
- Greater expansion subsector within technical textiles.
- World consumption$_{2000}$ = 1.5 10^6 Tm
- Annual growth = 4.6%

Medical textiles - Categories

- Non-implantable materials

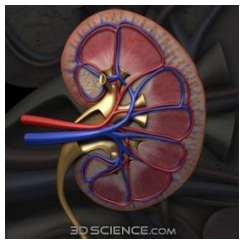



- Implantable materials




Artificial cornea

- Extracorporal devices

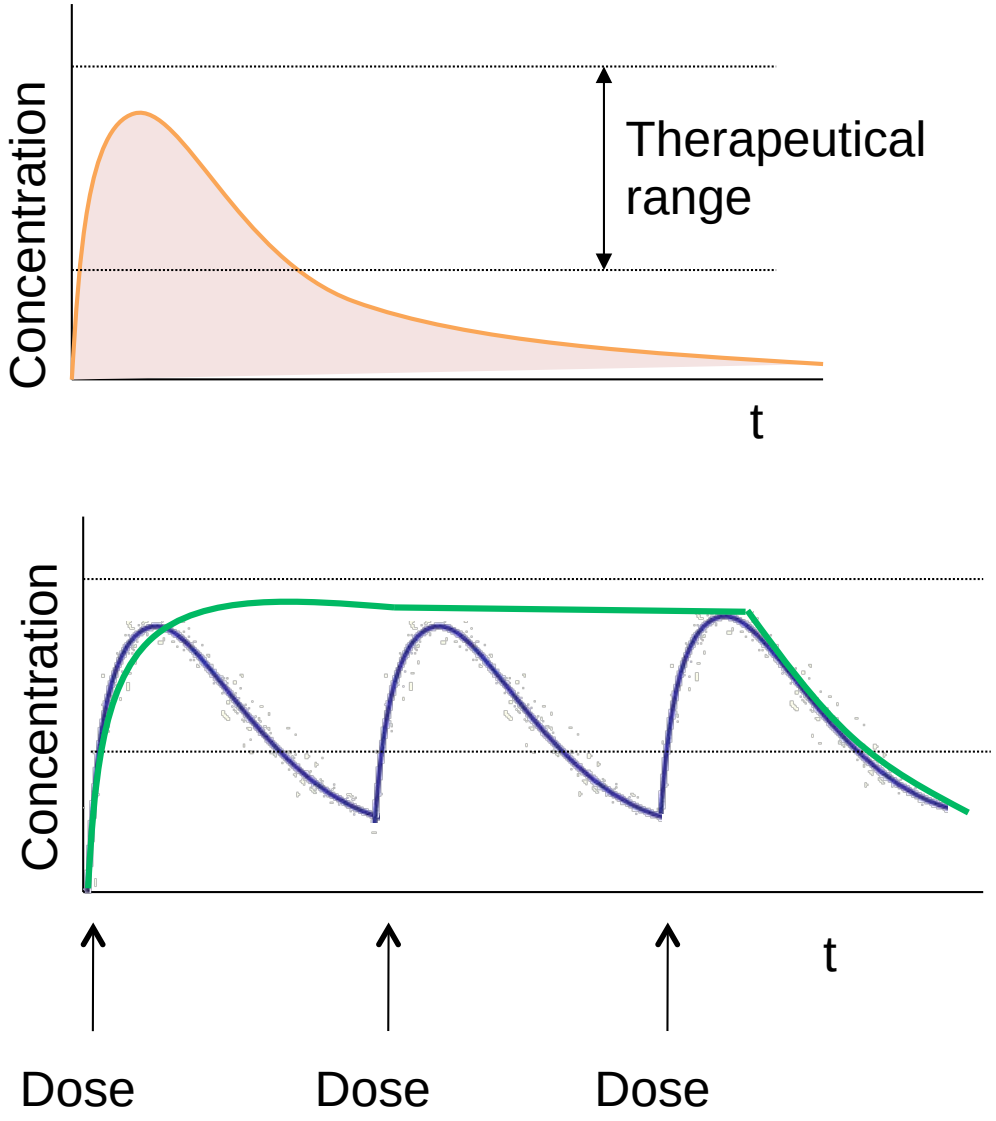


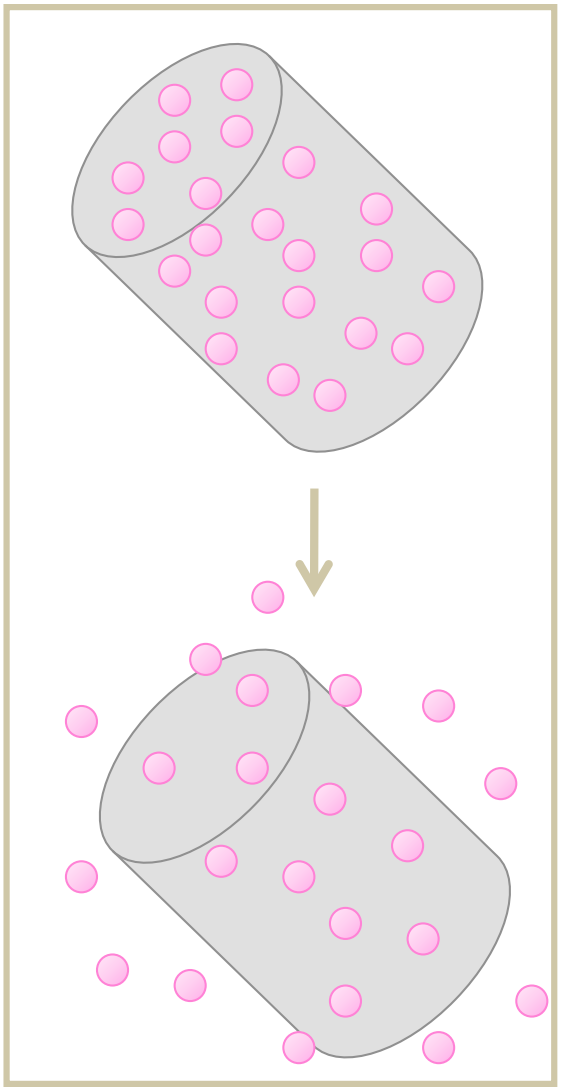
- Healthcare and hygiene products



S. Rajendran ,S.C. Anand, 'Development in Medical Textiles', Textile Progress, 2002, 10-13.

Interest of controlled drug delivery





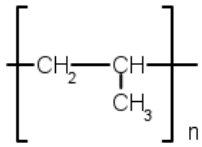
Objectives

- To investigate the surface modification of a PP nonwoven and a PA knitted fabric by Corona plasma and
- Its influence on release of a model drug.

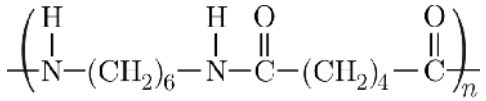
EXPERIMENTAL

Materials

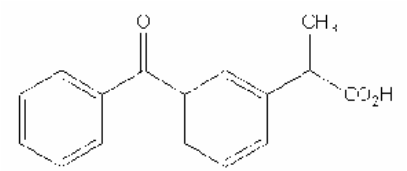
- **Textile materials :**
  - Polypropylene Nonwoven



  - Polyamide 6.6 Knitted fabric



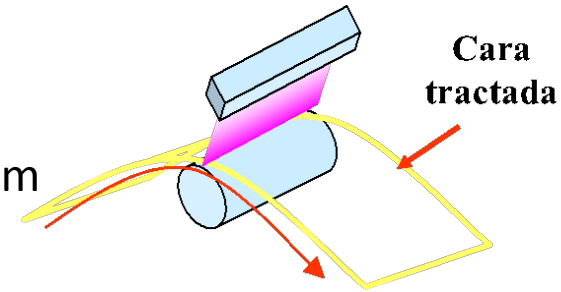
- **Drug model : Ketoprofen**



  - Nonsteroidal anti-inflammatory drug with analgesic and antipyretic properties
  - Undesirable gastrointestinal side effects after oral administration
  - Topical and transdermal administration one of the ways to overcome these side effects
  - Molecular weight : 254.3 $g.mol^{-1}$

Methods: Corona Plasma

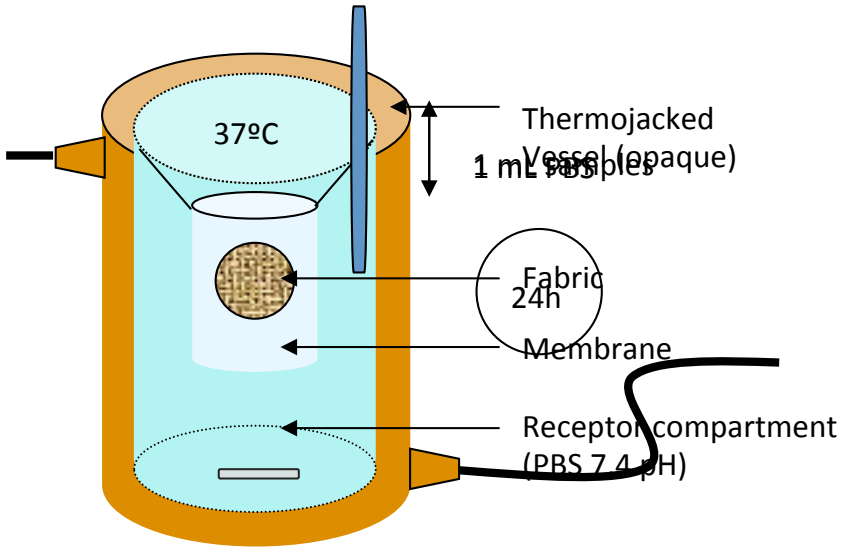
- Plasma treatments by *Ahlbrandt FG-2* corona plasma
- Ambient air as plasma gas
- Working conditions :
  - ❖ Distance between electrodes : 20-30 mm
  - ❖ Power = 1200 W
  - ❖ Speed = 15 rpm
  - ❖ Incident current = 1.90 A



- Fabrics treated for 1, 3, 10 or 20 plasma sequences
- 1 sequence = 0.35 s exposition time sample to the plasma

Methods: Drug release experiments

- Textiles impregnated with ketoprofen solution
- The diffusion cells consisted of a donor compartment and a receptor compartment separated by a permeable membrane
- Fabrics put in the membrane with PBS
- SINK conditions
- Samples withdrawn from receptor compartiment for analysis by spectrophotometry (λ=233nm)

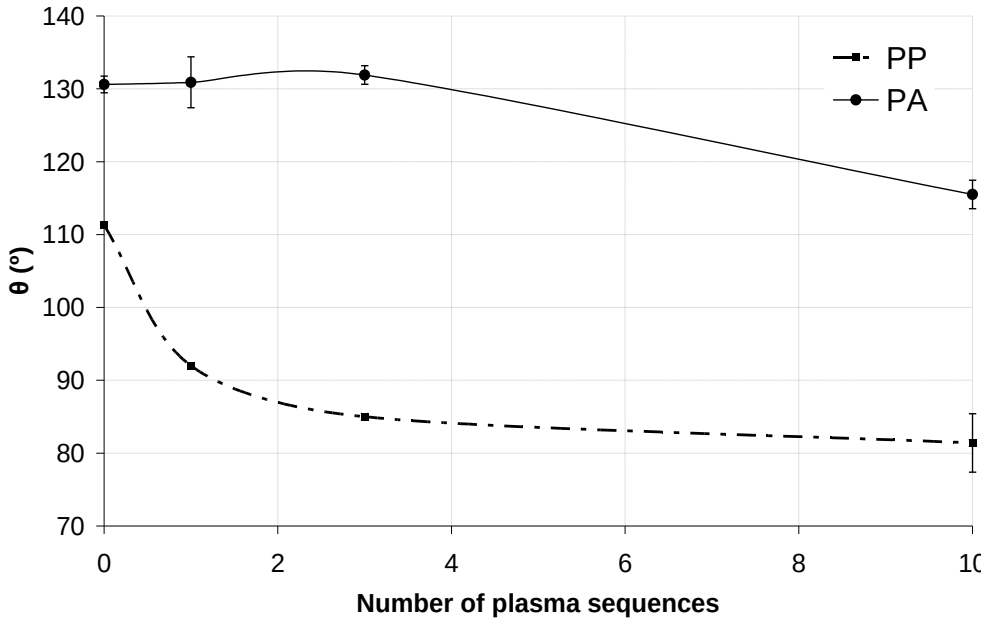


- 6 replicates

RESULTS AND DISCUSSION

Influence of plasma on wettability

Hydrophobic character



- Plasma treatment more efficient for PP
- No improvement of the wetting properties of the PA fabrics with only 3 plasma sequences

Influence of plasma on wettability

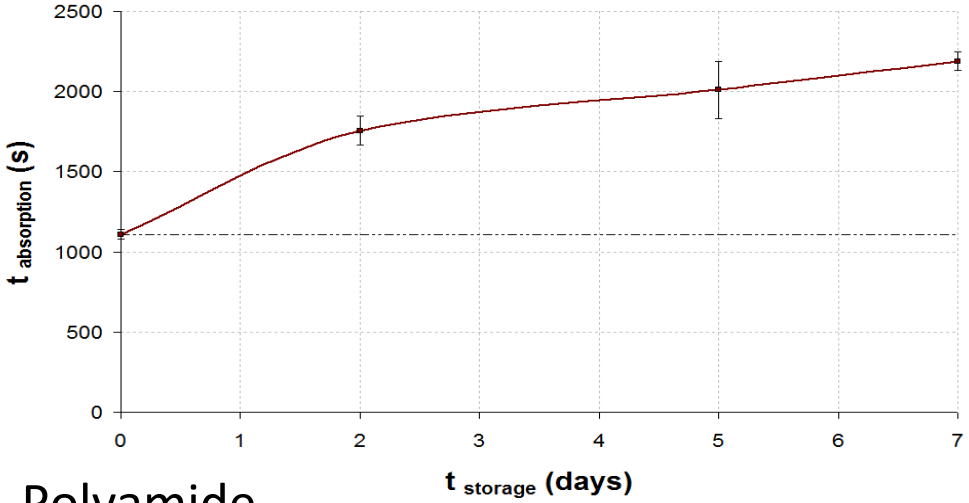
Hydrophobic character
t_{abs} > 6 s

	$t_{absorption}$ (s)	
Number of plasma sequences	PP	PA
0	> 10800	18.5 ± 0.5
3	9900 ± 900	19.0 ± 1.0
10	1080 ± 60	9.5 ± 1.0
20	510 ± 30	8.5 ± 1.0

- PA absorption time << PP absorption time
- Structure of PA allows capillary effects
- Faster t_{abs} reduction of PP by plasma than PA fabrics

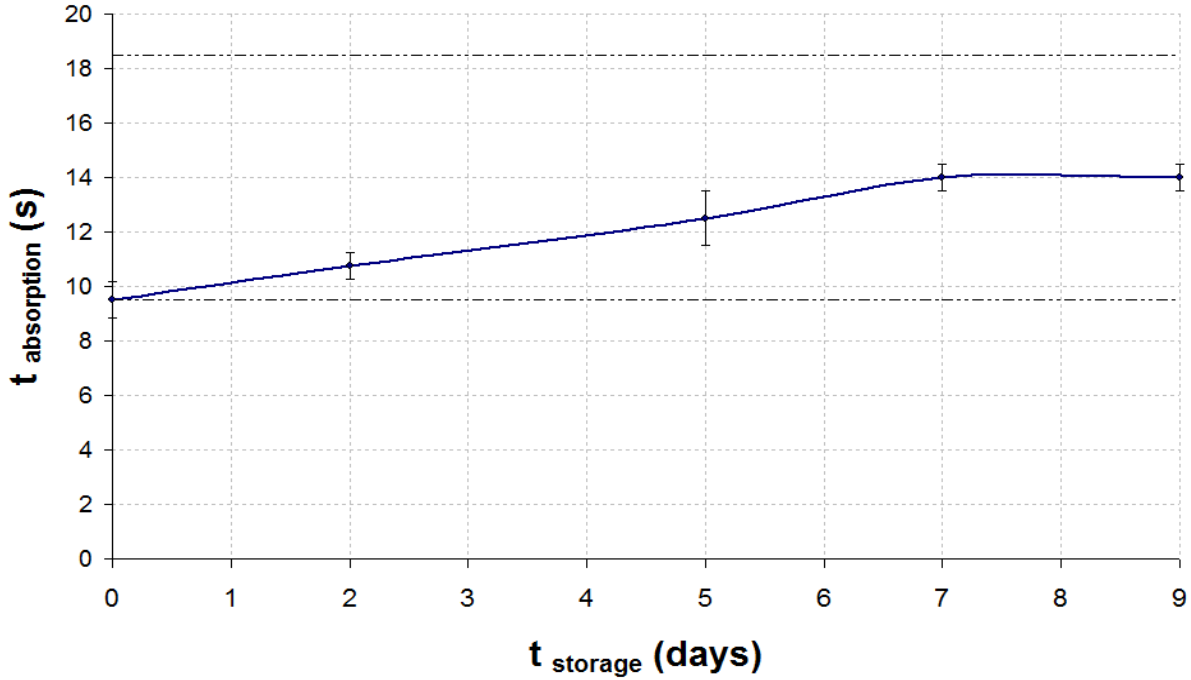
Ageing

Polypropylene



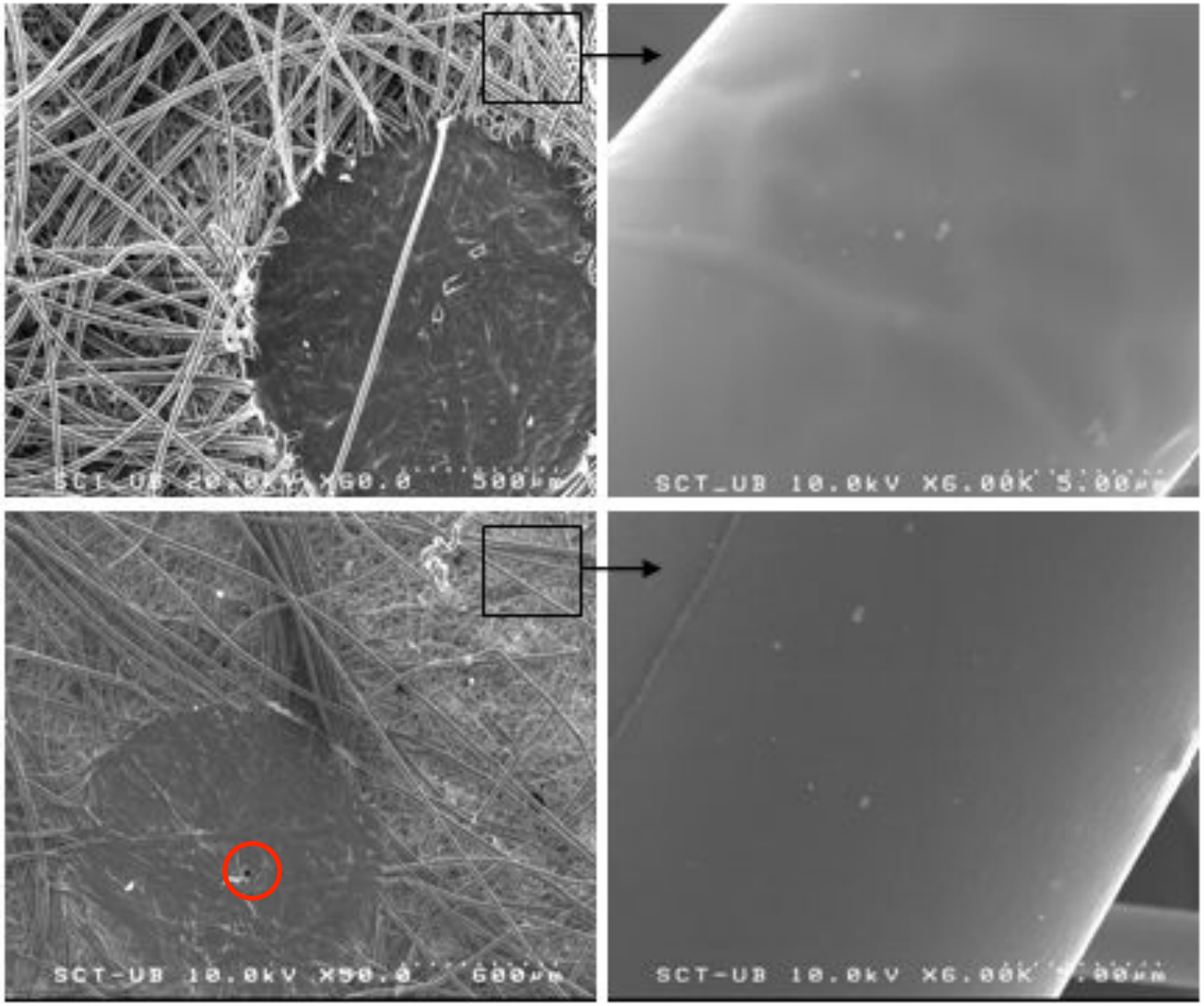
- Water absorption time of plasma-treated PP and PA tends to increase
- Moderate degradation process of the wetting properties

Polyamide



- Increase in hydrophobicity of the plasma-treated fabrics ⇔ Reorganization of chemical groups during storage

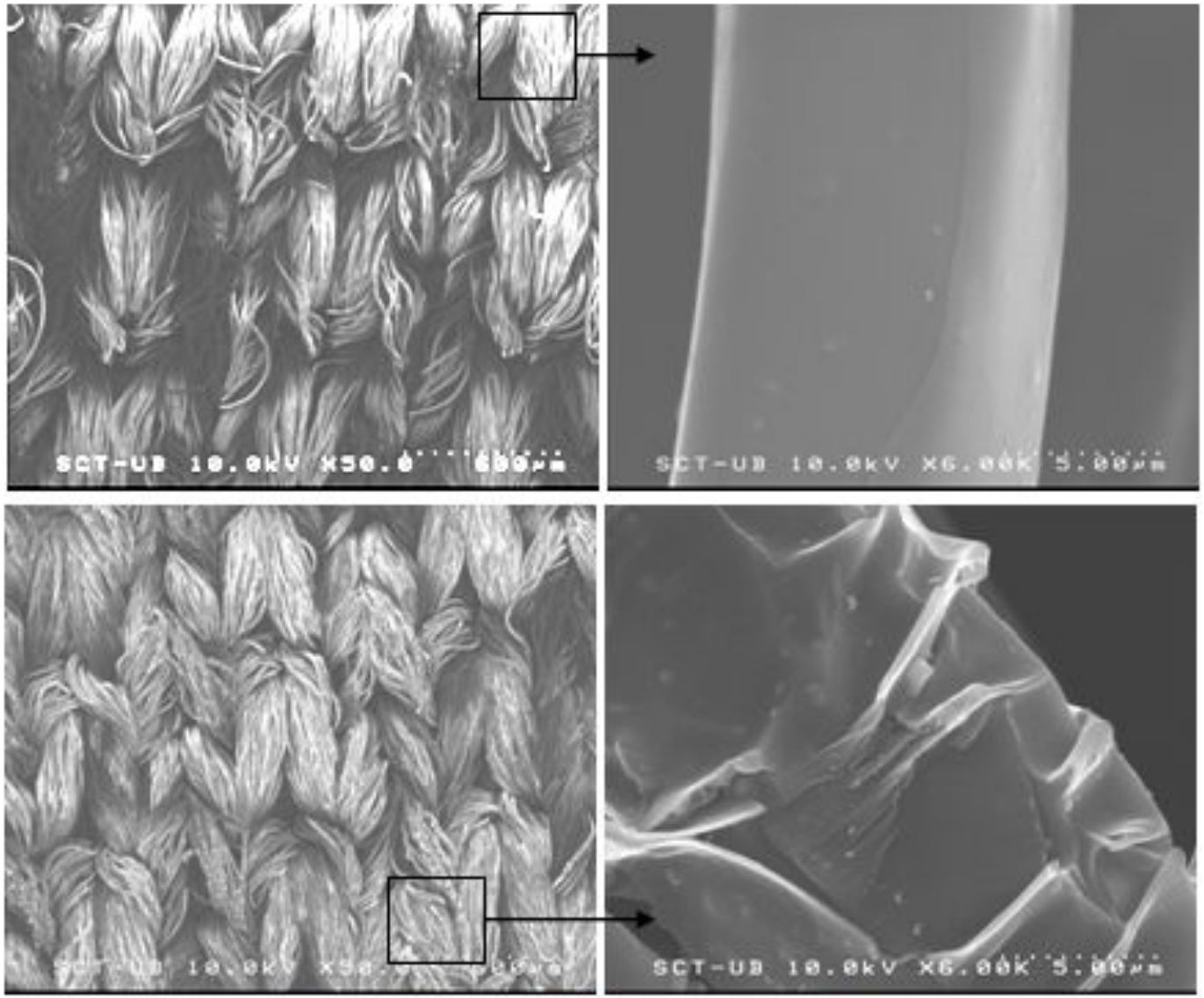
PP - Topography modifications



Untreated

10 plasma sequences

PA – Topography modifications

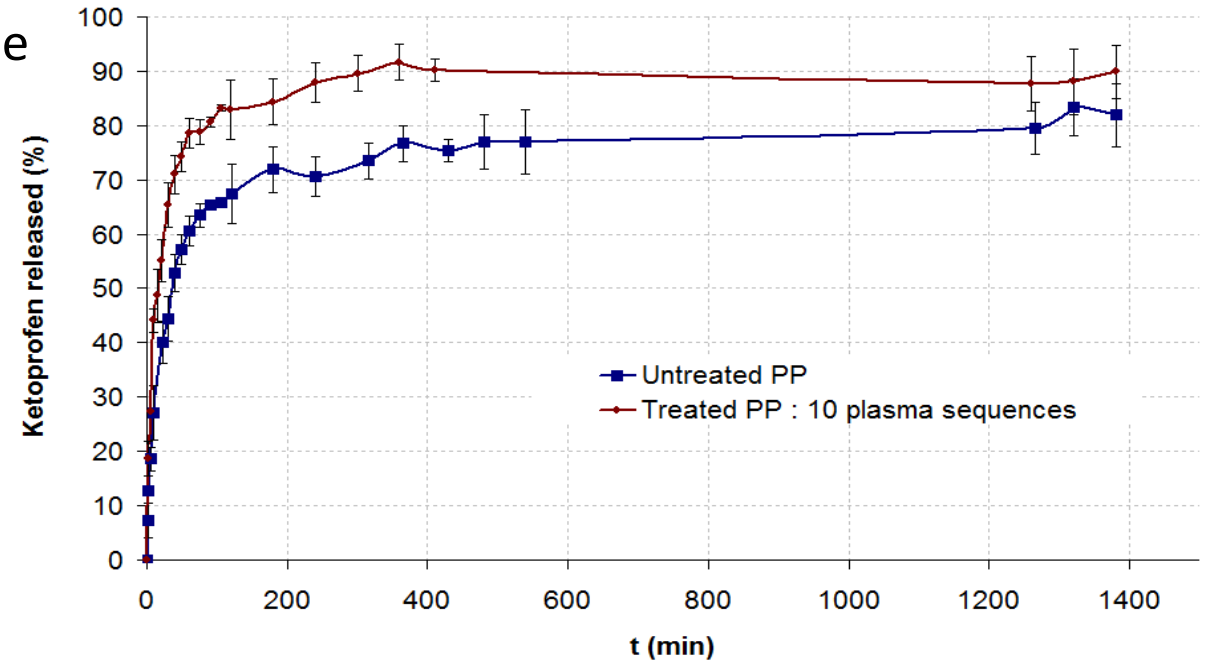


Untreated

10 plasma sequences

Influence of plasma on ketoprofen released

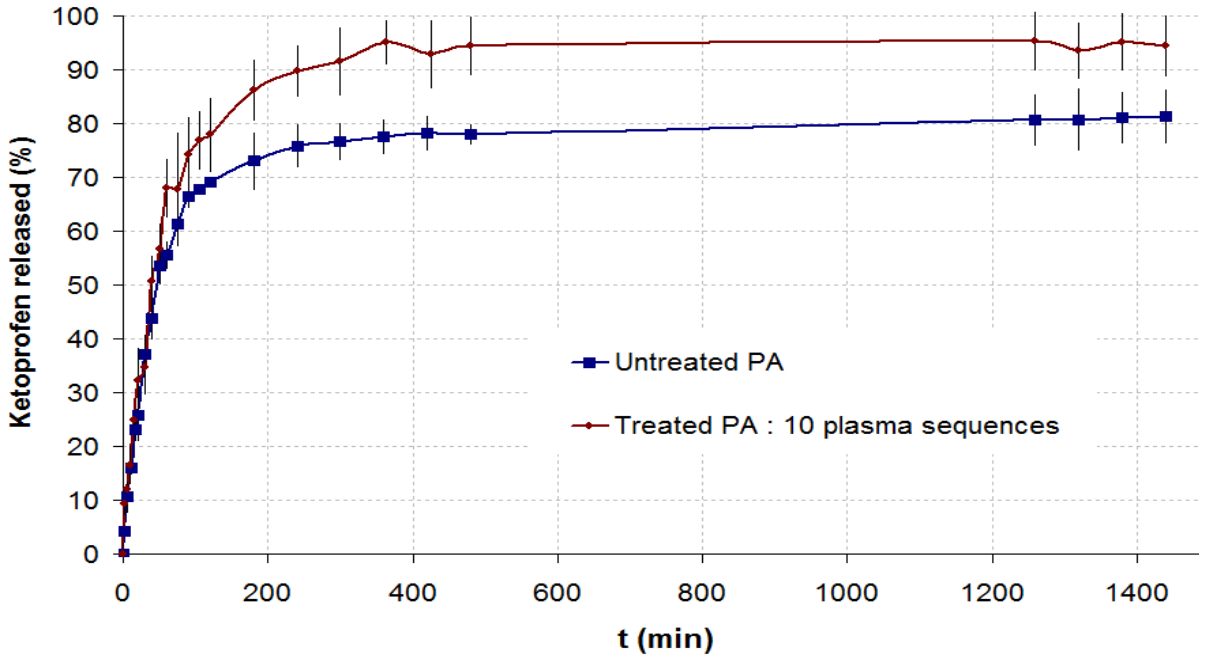
Polypropylene



- The maximum amount of ketoprofen released is achieved after 5-6 hours
- For plasma-treated fabrics
  - Faster initial release kinetics
  - The amount of ketoprofen released is slightly higher than w[illegible] treatment

Influence of plasma on ketoprofen released

Polyamide



- No differences were observed between ketoprofen released from untreated PP and PA fabrics
- For plasma-treated fabrics, the amount of ketoprofen released is higher than without treatment

Conclusions

- Plasma treatment **increased wettability of PP and PA**. The treatment is more effective for PP, as it becomes more hydrophilic with shorter plasma treatments than PA.

- Plasma-treated fabrics undergo a **moderate ageing process** that reduces the increased wettability acquired with plasma treatment.

- Topogrophical effects depend on the kind of fibre and fabric structure.

- Drug delivery experiments showed that plasma treatment of the fabrics **increases the percentage of ketoprofen released** with respect to untreated fabrics.

Thank you for your attention!

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