XXII IFATCC CONGRESS
STRESA - LAGO MAGGIORE
MAY 5 - 7th, 2010

FROM

TEXTILE

CHEMISTRY

TO FASHION:

MULTIFUNCTIONALITY,

SUSTAINABILITY,

COMPETITIVITY

ATMOSPHERIC PLASMA-ENHANCED CVD ON TEXTILES

ADRIANO FONTANA

ARIOLI SPA

PLASMA ?

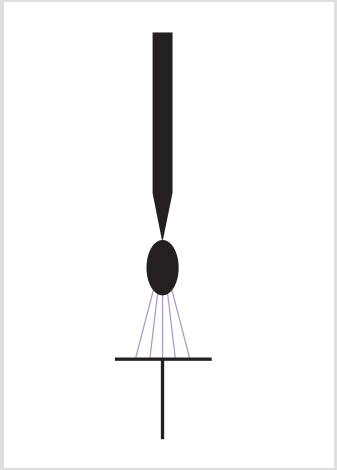
TODAY, HERE I SUPPOSE EVERYONE KNOWS WHAT WE ARE TALKING ABOUT!

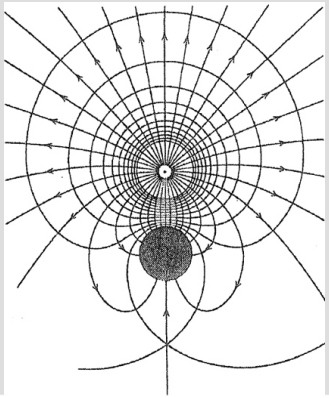
(High energy ionized atmosphere)

- **Superficial ablation of material (*etching*)**
- **Generation of free radicals on the surface (*activation*)**
- **Insertion of atoms or groups (*grafting*)**
- **Thin layer deposition of polymers on the surface in gaseous phase (*film deposition*)**

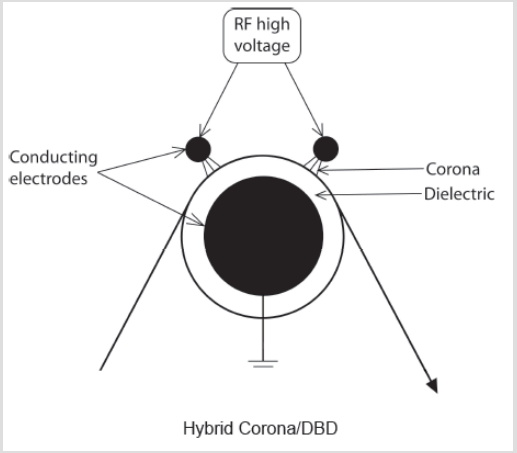
ARIOLI'S ATMOSPHERIC CHOICE

CORONA



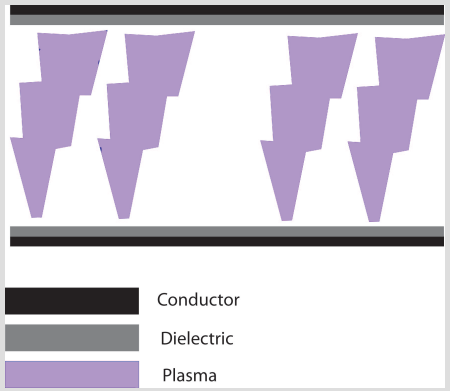


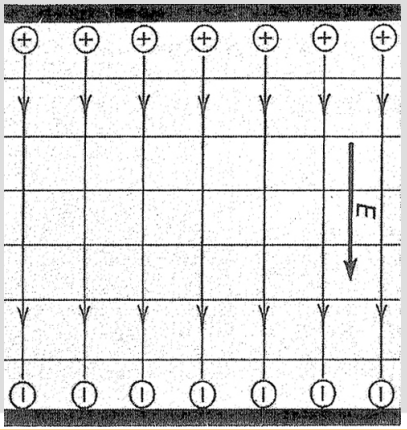
HYBRID CORONA - DBD



Hybrid Corona/DBD system: elements of both its Corona and DBD parents, with an asymmetric electric configuration typical of Corona coupled with the DBD's dielectric covering on the grounded electrode.

DBD





A RECENT HISTORY

- **2002 - R&D START**

- **2007 – ITMA MUNICH**

ATMOSPERIC PLASMA AS PREPARATION TO ENHANCE THE EFFECT OF TRADITIONAL TREATMENTS (ACTIVATION AND ETCHING)

- **2008-09 INDUSTRIAL APPLICATIONS**

TODAY

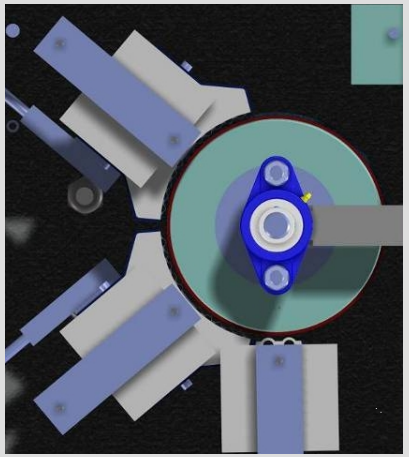
GRAFTING AND FILM DEPOSITION

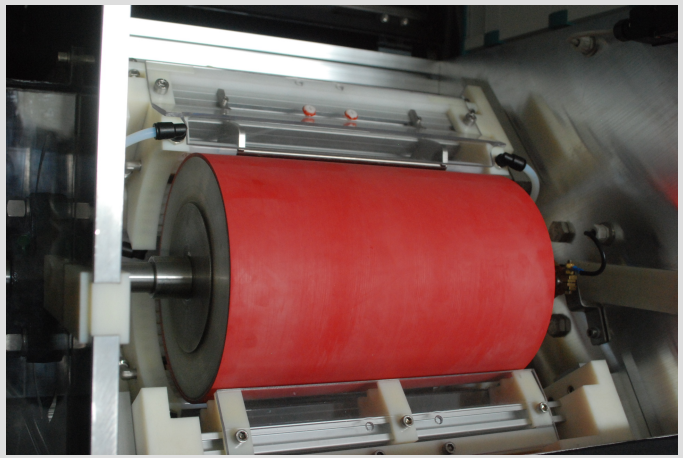
LABORATORY UNIT

- HF GENERATOR ~1-15 kV peak-to-peak from 25 to 80 kHz
- Continuous or pulse & pause discharge
- Speed from 5 to 50 m/min

LABORATORY UNIT

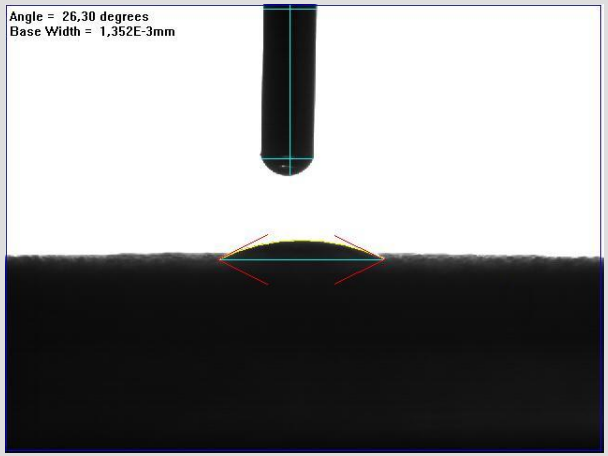
- Multi electrodes geometry
- Discharge zone with a “double atmospheric chamber”
- Dosing and injection of gas, gas mixtures and vapors
- Continuous injection (pre- post- along the process)



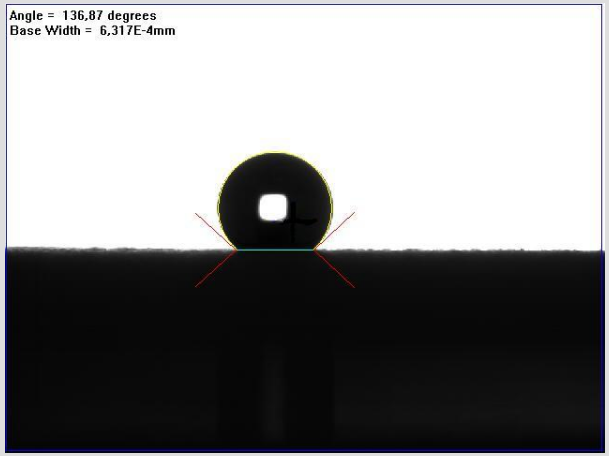


FIRST RESULTS

- DEPOSITION OF WATER-REPELLENT HMDSO FILMS ON TEXTILES
  - COTTON
  - SILK
  - POLYESTER
  - POLYAMIDE



NT

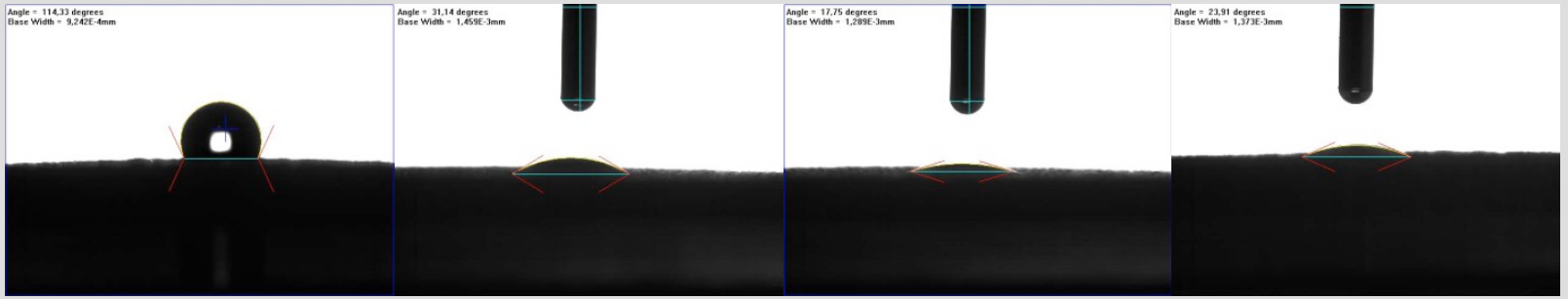


HDMSO

HMDSO FILM DEPOSITIONS

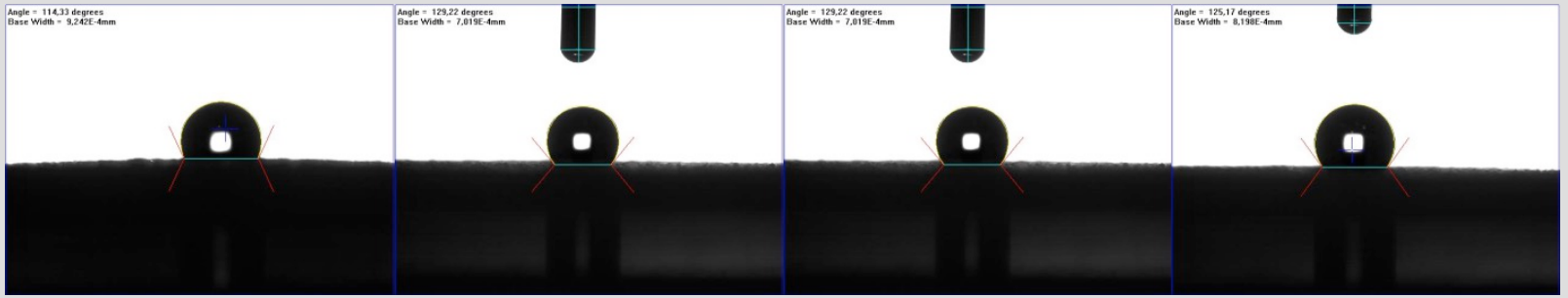
Effects of the environment on the efficiency of the process

AIR

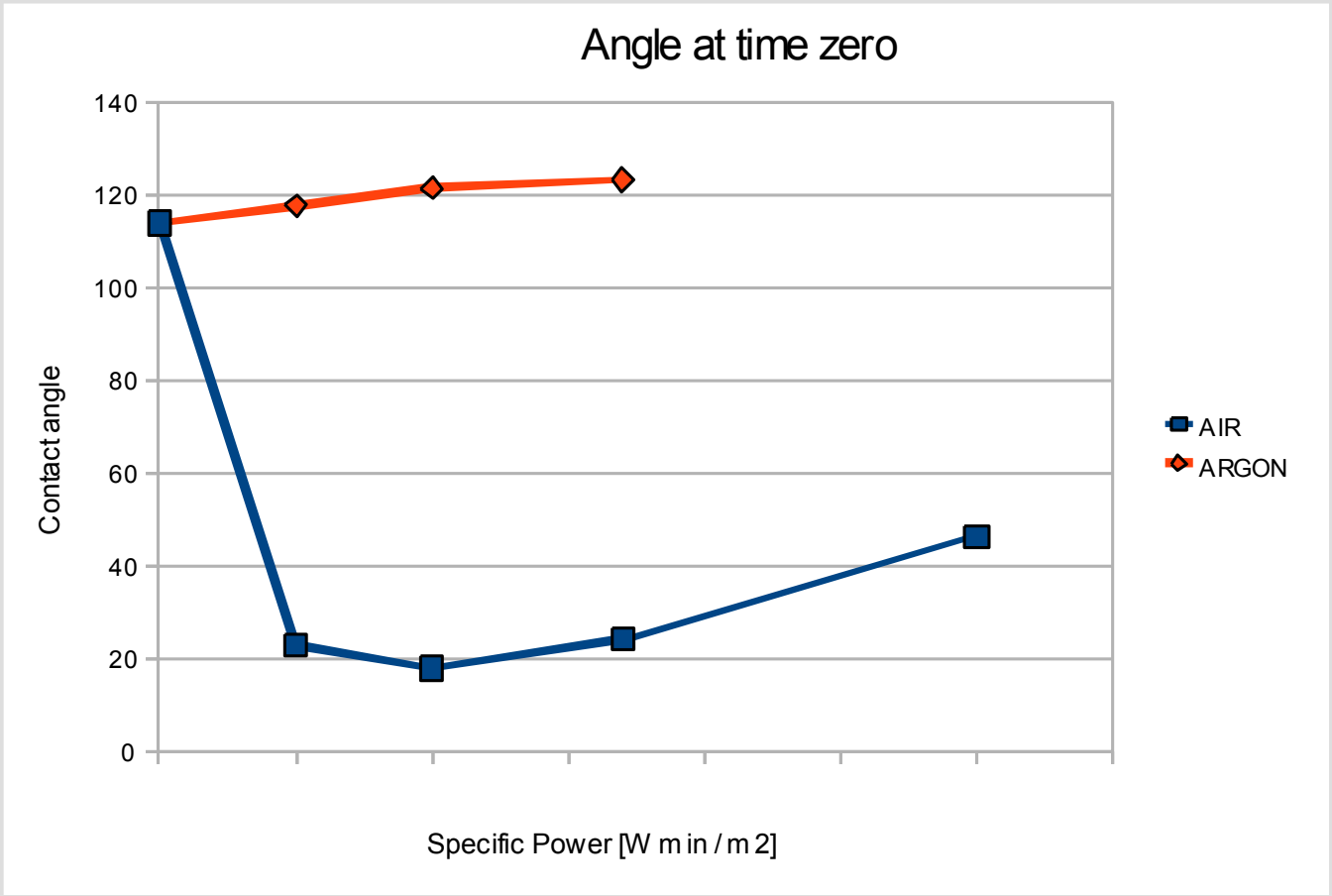


Low power **(t0)** **High power**

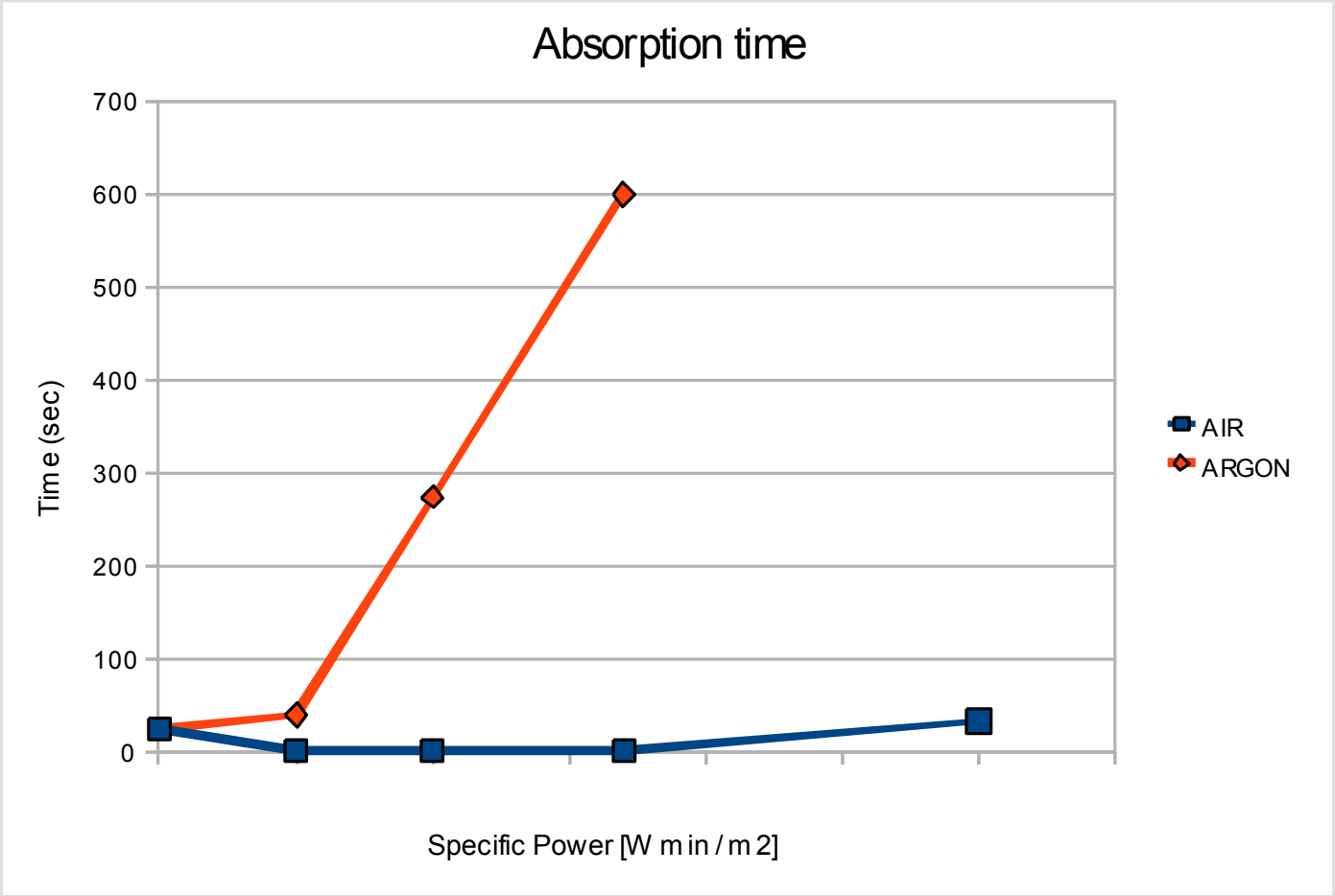
Ar



AIR Vs ARGON


Angle at time zero
140
120
100
80
60
40
20
0
Contact angle
Specific Power [W m in / m 2]
AIR
ARGON

AIR Vs ARGON


Absorption time
700
600
500
400
300
200
100
0
Time (sec)
Specific Power [W min / m2]
AIR
ARGON

IR Analysis:
NT Vs HMDSO/Ar

Silk

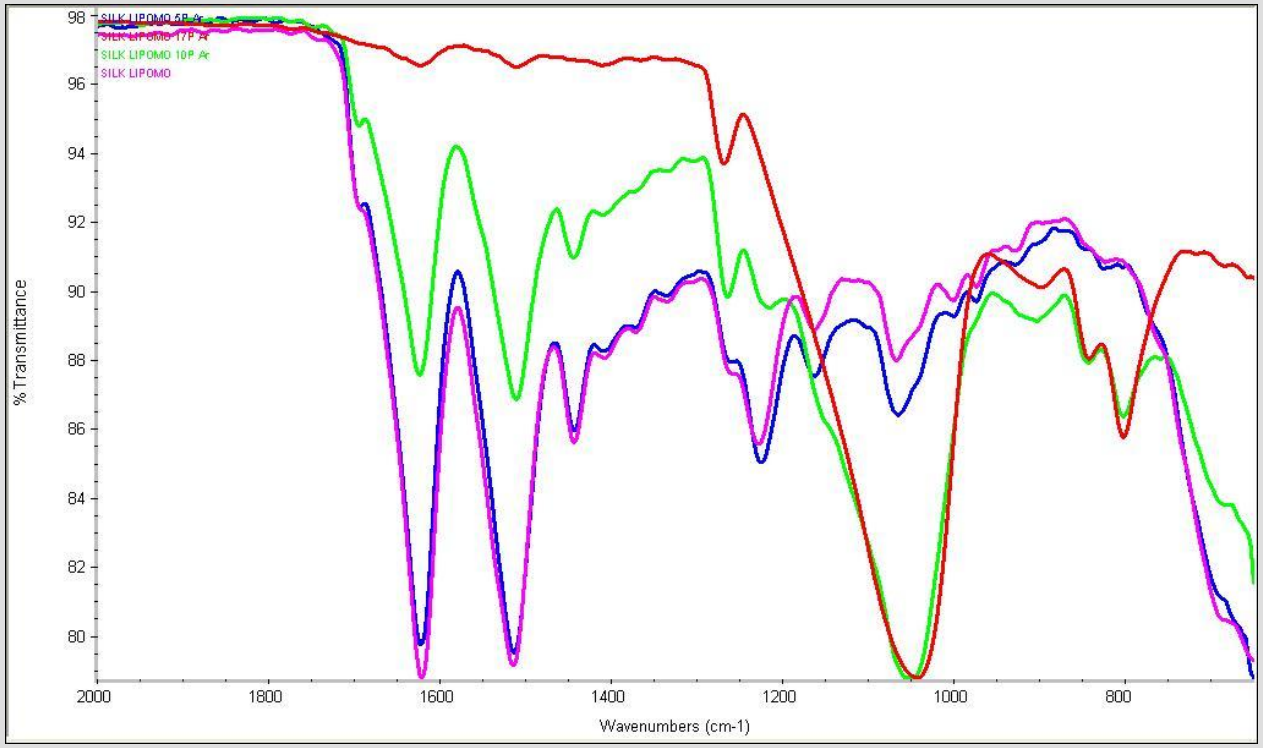
Added groups

1080 cm^{-1} Si-O-Si

1030 cm-1 Si-O-C

850 cm-1 Si-C

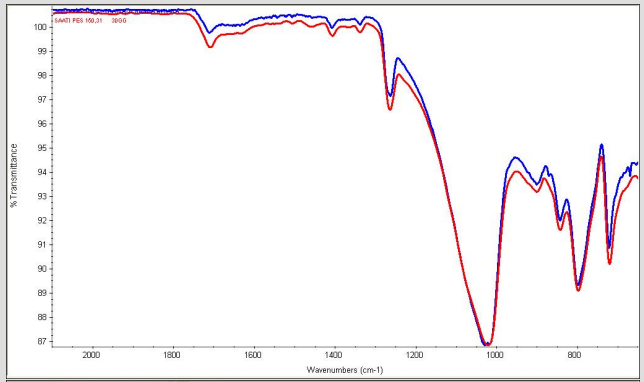
790 cm-1 CH3-Si-CH3



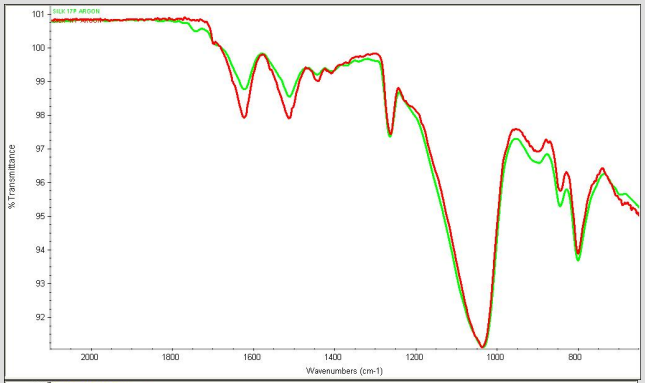
PINK = NT
BLUE = LOW SPEC. POWER
GREEN = MEDIUM SPEC. POWER
RED = HIGH SPEC. POWER

HMDSO DEPOSITION:
NO DECAY AFTER 30 days

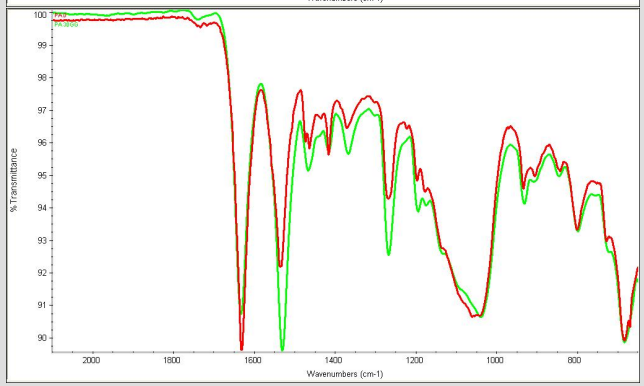
POLYESTER



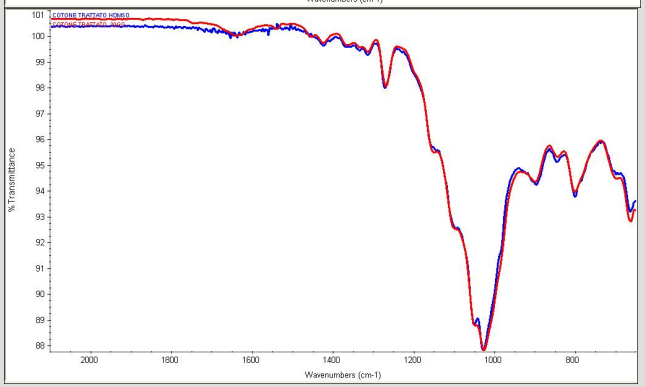
SILK



POLYAMIDE



COTTON



WASHING FASTNESS
WATER 5/10/15 TIMES

IR ANALYSIS

EXCELLENT WATER WASHING FASTNESS

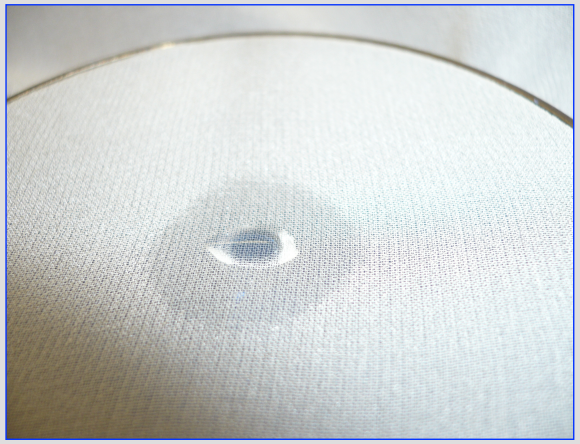
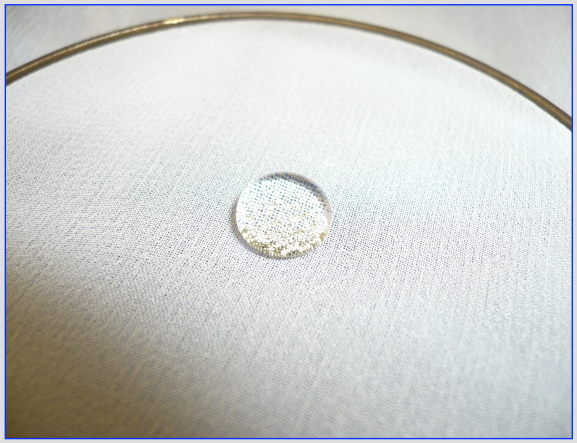
WASHED FABRICS IR ARE MORE OVERLAPPED

WASHING INCREASE UNIFORMITY ELIMINATING EXCESS MATERIAL

Silk

WASHING FASTNESS
WATER 5/10/15 TIMES

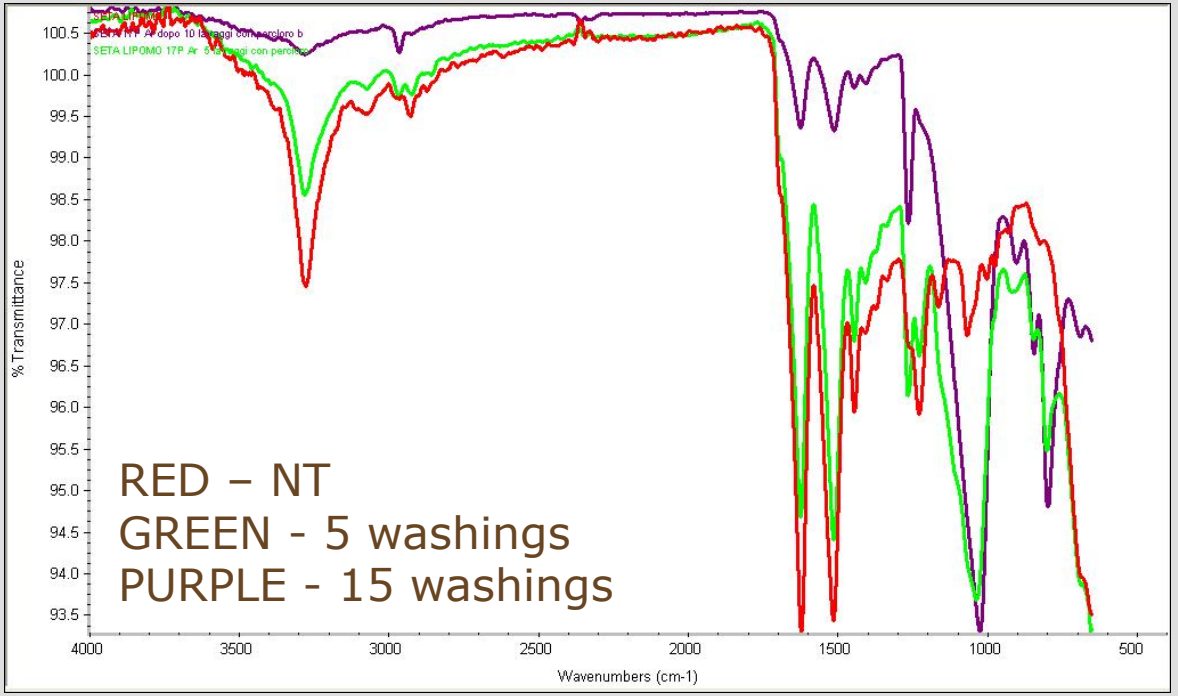
SESSILE DROP CONTACT ANGLE ANALYSIS

NT	HDMSO/Ar PLASMA Before water washing	HDMSO/Ar PLASMA After 15 water washings
		
ABSORPTION TIME < 1 SEC	ABSORPTION TIME > 5 MIN	ABSORPTION TIME STILL > 5 MIN

WASHING FASTNESS PERCHLORO 5/10/15 TIMES

IR ANALYSIS

EXCELLENT PERCHLORO WASHING FASTNESS

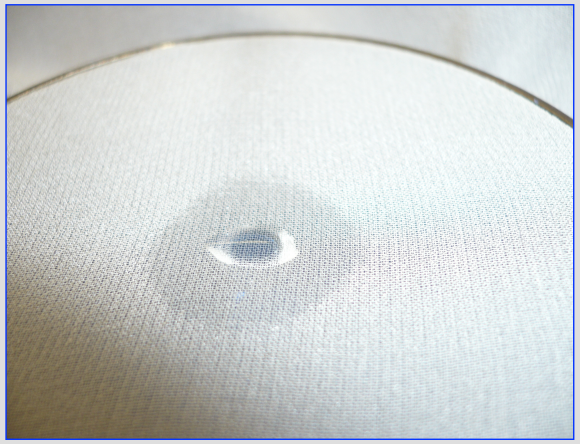


Silk

WASHING FASTNESS PERCHLORO 5/10/15 TIMES

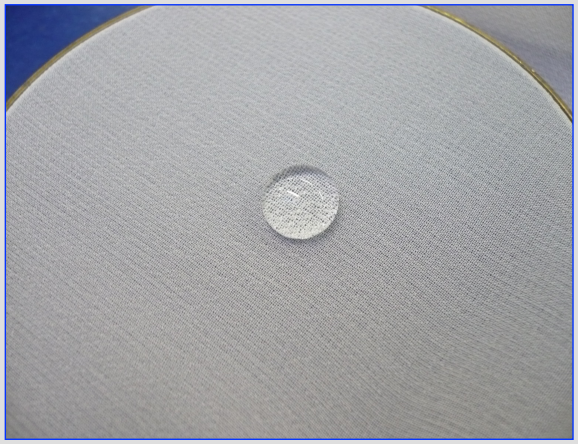
SESSILE DROP CONTACT ANGLE ANALYSIS

NT



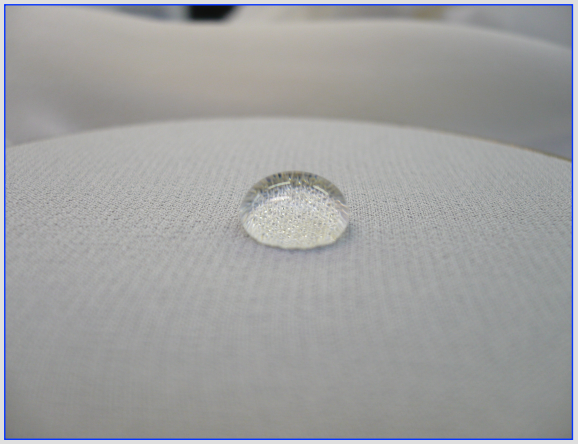
ABSORPTION TIME
< 1 SEC

HDMSO/Ar PLASMA
Before perchloro washing



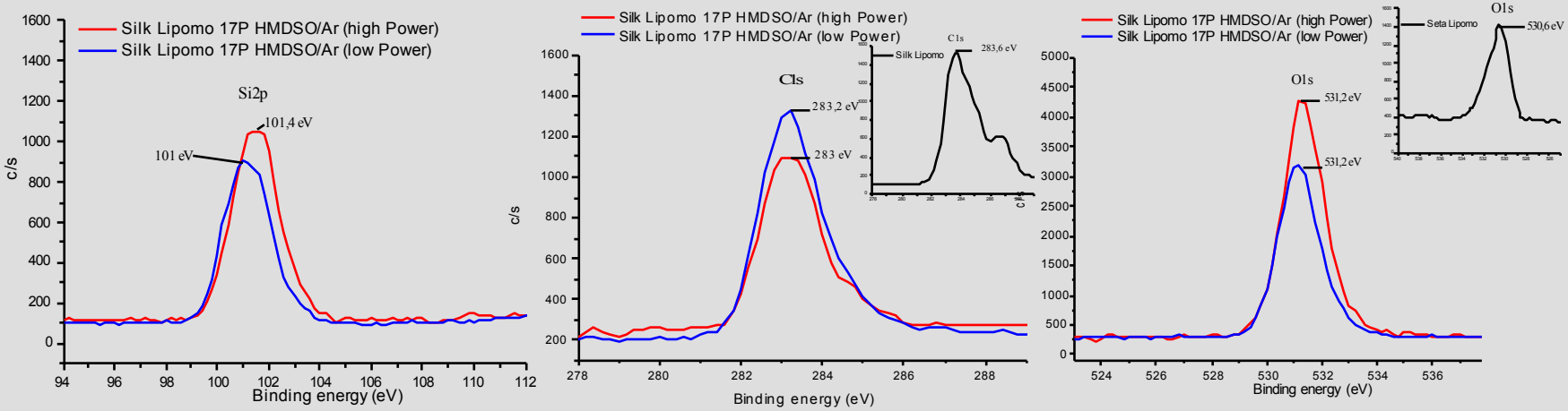
ABSORPTION TIME
> 5 MIN

HDMSO/Ar PLASMA
After 15 perchloro washings



ABSORPTION TIME
STILL > 5 MIN

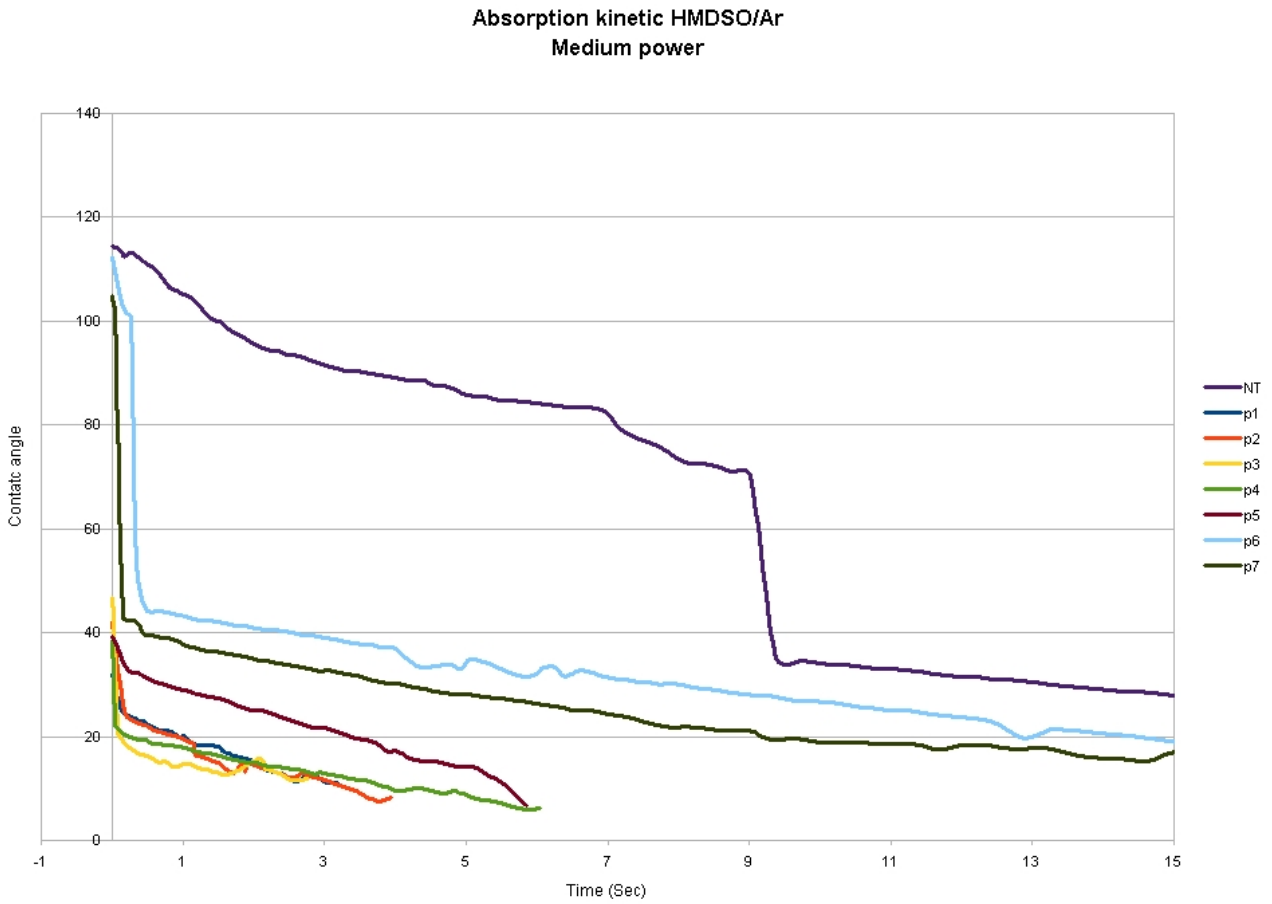
XPS



- **C1s O1s diagrams compared to silk standard tell us the fabric is completed covered by the film deposed by atm. plasma.**
- **High power plasma (RED) give us high level Si2p and O1s energy peaks, SILICA LIKE film.**
- **Low power plasma (BLUE) give us low level Si2p and O1s energy peaks, SILICON LIKE film.**

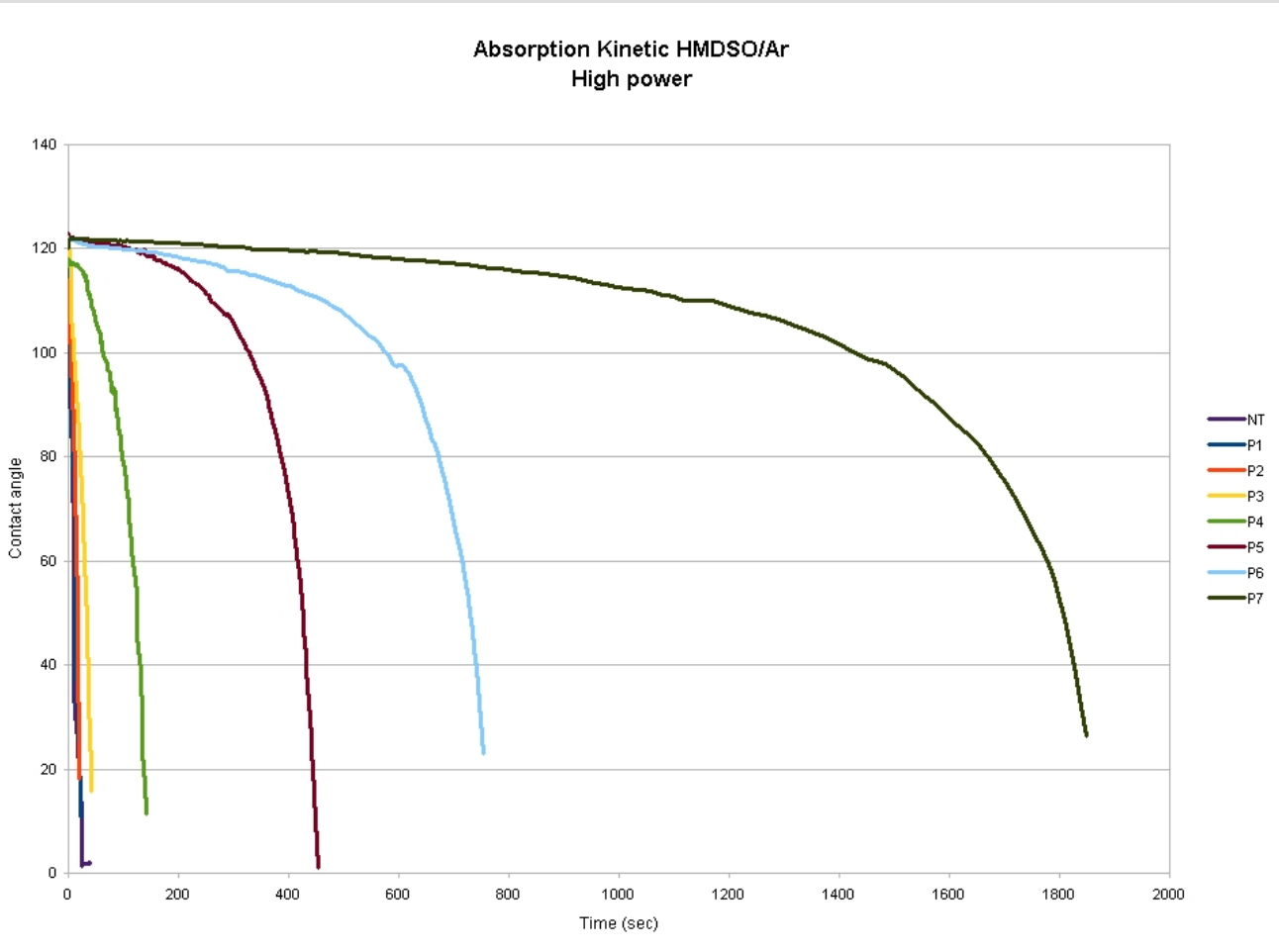
SILICON LIKE

Hydrophilic behavior



SILICA LIKE

Hydrophobic behavior



TEXINNOVA PROJECT

Partnership

Politecnico di Torino

ARIOLI

Stazione Sperimentale per la Seta
SSS
Textile Research Centre
Centro di Ricerca Tessile

Successori Giuseppe Cattaneo

Stamperia di Lipomo

SAATI GROUP

cifra

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