STABLE LOW SURFACE ENERGY WITH ADJUSTABLE RELEASE PROPERTIES

Very low surface energy materials present interesting properties, they are used applications such as anti-graffiti, anti-stain, easy-cleaning, biomedical, technical textile etc. However, those materials are usually quite expensive and not easily recycled. Atmospheric pressure plasma enhanced chemical vapor deposition (AP-PECVD) allows to transfer those properties to common polymeric materials. Very low surface energy materials are then obtained for a fraction of the cost and they present better recyclability than traditional low surface energy materials.

In this study, PET, a polyester polymer with a relatively high surface energy (46 mN/m), has been coated with a hydrophobic layer using CPI's atmospheric pressure plasma technology.

After CPI atmospheric pressure plasma treatment, the water contact angle (WCA) measured on the PET film surface is strongly increased. The hydrophilic film surface (WCA ‹ 90°) has turned hydrophobic (WCA › 90°). *(Fig.1)*

The change in surface energy is related to the composition of the coating deposited on the film. In this case the deposited coating has a chemical structure comparable to low surface energy silicone as evidenced by Figure 2.
By adjusting the process parameters it's possible to control the hydrophobicity of the sample as well as the release properties of the film.

Fig. 1

Water droplets deposited on PET film before (left) and after CPI atmospheric plasma coating (right)

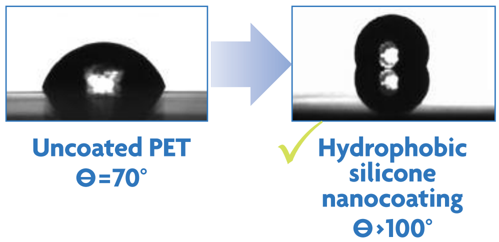
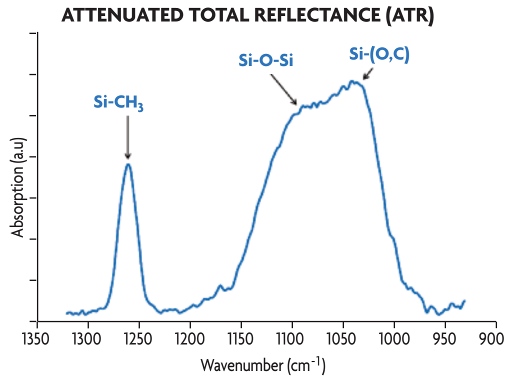


Fig. 2

Chemical characterization of the deposited coating by infra-red spectroscopy (ATR mode)



Tab. 1

Hydrophobic and release coating properties - Peel force of 3M810 tape measured with AR1000 apparatus.

Plasma coating conditions			Water Contact Angle [°]	Peeling Force [N/cm]
Coating Reference	Plasma Dosage	Monomer Flow rate		
Uncoated	N/A	N/A	70.7 +/- 1.1	2.34 +/- 0.13
1	Low	High	102.9 +/- 0.7	1.52 +/- 0.07
2	High	Low	98.8 +/- .3	0.65 +/- 0.15

BARRIER COATING ON 3D SHAPED CONTAINER

Good barrier properties are of particular importance especially in food and pharmaceutical packaging applications. They allow to extend to product shell life by limiting contact with oxidizing agent such as H_2O and O_2.

CPI was able to highly improve barrier properties of polymeric substrates by depositing high quality coating using vacuum plasma. This coating contains only 2 layers but still shows excellent Oxygen transmission rate (OTR) and Water transmission rate (WTR) results.

The coating was first deposited on PET and PP films. To optimize the chemistry parameters before depositing the same coating on 3D containers.

The measured OTR and WTR values of the films are given in Table 1.

Tab. 1

OTR and WTR values for treated films

Substrate	Recipe	OTR1	OTR2	OTR before treatment	WTR1	WTR2	WTR before treatment
PET 12 µm	1	0.7	0.4	110	0.21	0.22	35
PP 20 µm	2	11.2	9.6	1800	0.11	0.09	9

The calculated Barrier Improvement Factor (BIF) are given in the following table

Tab. 2

Calculated BIF factors for the treated films

	BIF O_2	BIF H_2O
Testing Conditions	23°C – 50%RH	38°C – 90%RH
PET 12 µm	288	187
PP 20 µm	192	97

After having validated the optimal treatment parameters for the targeted application, the coating was deposited onto a polypropylene (PP) container.

The calculated BIF for O_2 on th container was superior to 100.

As shown by the calculated BIF value, CPI was able to successfully improve barrier properties on 3D shaped PP substrate with a relatively simple process (only 2 layer).

Fig. 1

Schematic of the layer arrangement on the container. The coating was deposited both inside and outside of the container.