Roll-to-roll nanofiber PFAS-free ultra-thin coating for filtration membranes to enhance hydrophobicity

PTFE (Teflon) is a PFAS polymer widely used in filtration membranes. Gore-Tex, for example, is PTFE-based and offers excellent hydrophobicity and oleophobicity without a need for extra coating. Historically, PTFE membranes have been dominant, making PFAS-free alternatives less viable. However, the growing regulatory and consumer push against PFAS has created an opportunity for innovative, PFAS-free alternatives.

PFAS (Per- and Polyfluoroalkyl Substances) are a group of synthetic chemicals used in a variety of industrial and consumer applications due to their water- and oil-repellent properties. However, PFAS are known as “forever chemicals” since they are persistent in the environment and human body, leading to concerns over their potential health risks. Regulatory agencies worldwide are now imposing restrictions and exploring alternatives to reduce PFAS dependency.

With PFAS-free membranes, a coating is needed to enhance surface properties such as hydrophobicity or oleophobicity.

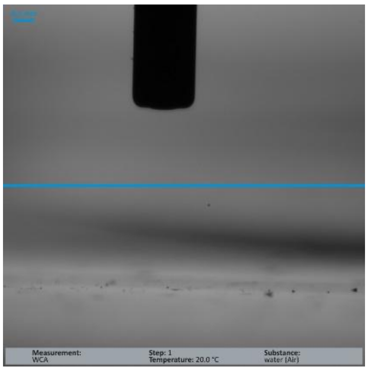
Europlasma has leveraged its experience in plasma coatings and roll-to-roll machines to test integration of **PFAS-free hydrophobic coatings and plasma-enhanced roughening in a single process step** on different types of membranes, including **high-sensitive nanofiber** membranes which are difficult to tread. Plasma processes are solvent free and use small amounts of chemicals.

Results in performance for different membrane types - Water Contact Angle (WCA) Measurements

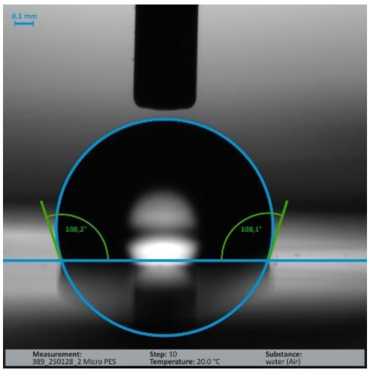
Hydrophilic (PFAS-Free) nanofiber membrane:

- **Untreated membrane**: Fully absorbs water, WCA unmeasurable. Hydrophilic.
- **Membrane + 25 nm PlasmaGuard S coating**: Hydrophobic, WCA = 109°.
- **Membrane + Nanotexturing + PlasmaGuard S**: Enhanced hydrophobicity, WCA = 127°.

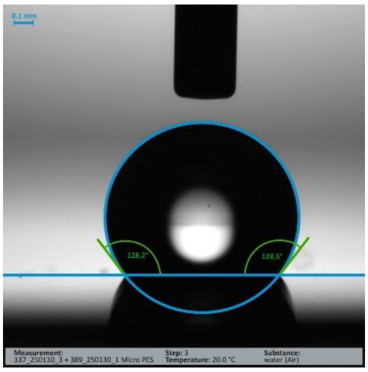
MATERIAL	ROUGHENING	COATING TYPE	AVERAGE WCA
Hydrophilic Nanofiber membrane	No	Untreated	
	No	PlasmaGuard S 25 nm	109
	Nanotexturing with Plasma	PlasmaGuard S 25 nm	127



Untreated



PlasmaGuard S 25 nm



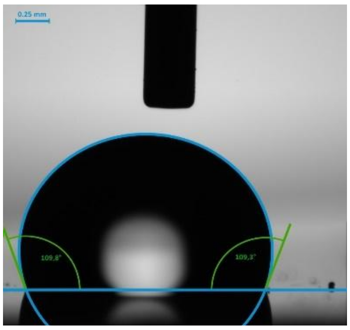
Roughening +

PlasmaGuard S 25 nm

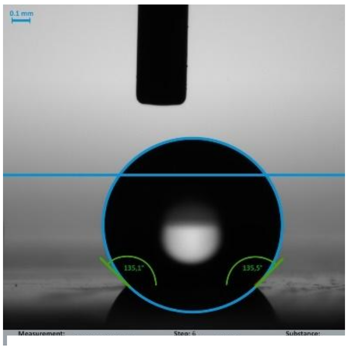
Hydrophobic (PFAS-free) nanofiber membrane:

- **Base membrane**: WCA = 109°.
- **PlasmaGuard S - coated membrane**: WCA = 130°.
- **Nanotextured + PlasmaGuard S membrane**: WCA = 145°.

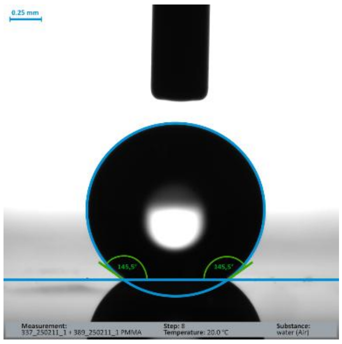
MATERIAL	ROUGHENING	COATING TYPE	AVERAGE WCA
Hydrophobic Nano fiber membrane	No	Untreated	109
	No	PlasmaGuard S 25 nm	131
	Nanotexturing with Plasma	PlasmaGuard S 25 nm	145



Untreated



PlasmaGuard S 25 nm



Hydrophobic membrane Roughening

THE TECHNOLOGICAL ADVANTAGE

- Environmentally friendly coating
- PFAS-free coating and roughening in one process step increases performance in a roll-to-roll machine
- Significantly enhances hydrophobicity and enables super hydrophobicity
- Can be applied to virtually any polymer membrane or filtration medium
- Developed as part of our patented PGs PFAS-free coating platform
- Plasma-enhanced coating offers ultra-thin (25 nm) and highly conformal applications
- Preserving breathability thanks to the ultra-thin layers
- Enables tunable water contact angles to match customer needs
- Solvent free

TYPICAL APPLICATIONS

- Medical membranes
- Acoustic membranes
- Air filtration

Thanks to its unique combination of a plasma-enhanced roll-to-roll PFAS-free coating and plasma-enhanced roughening platform, Europlasma has successfully tested the integration of these two technologies in a single process step. This allows for the treatment of a wide range of non-woven materials, membranes, and polymers, significantly enhancing their surface properties.

Plasmalex delivers both chemistries and equipment for surface treatment on an industrial scale.

You can find the overview of our full range of equipment at www.plasmalex.com/solution/#equipmentoverview