R2R-process development for PECVD-coating and microstructuring for customized anti-ice foils

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Ice formation on surfaces affects the functionality of numerous means of transport as well as technical equipment - for example the wings of aircraft or the rotor blades of helicopters or wind turbines - and reduces their efficiency and safety. In the particular case of helicopters, passive deicing technology is desired to extend the operational availability (e.g. mountain rescue in winter or during bad weather), and to reduce CO_2 and NO_x emissions. In addition, safety for passengers, crews and third parties in aviation can be increased by such technologies as well.

With the development of a two-step R2R-process, an important step for passive in-flight deicing of small and medium helicopters is addressed.

The passive de-icing system consists of a microstructured, plasma-coated and self-adhesive PU foil. It can be customized in order to address different icing conditions. The system works in three steps: due to its superhydrophobic microstructures, the wetting is reduced. Second, by limiting the surface contact area, the ice formation is delayed. In addition, these films exhibit low adhesion of ice. The anti-icing foils can be applied flexibly to surfaces that are particularly susceptible to icing.

In our work, two separate R2R processes (structuring and coating) were successfully combined. The structures were obtained by hot-embossing. Hydrophobic properties were achieved by either applying ultrathin fluorocarbon plasma polymers or, as an alternative, fluorine-free silicone-like coatings based on HMDSO.

For the optimization, different production routes have been used as illustrated in Figure 1. The different outcomes, advantages and limitations will be discussed in detail.

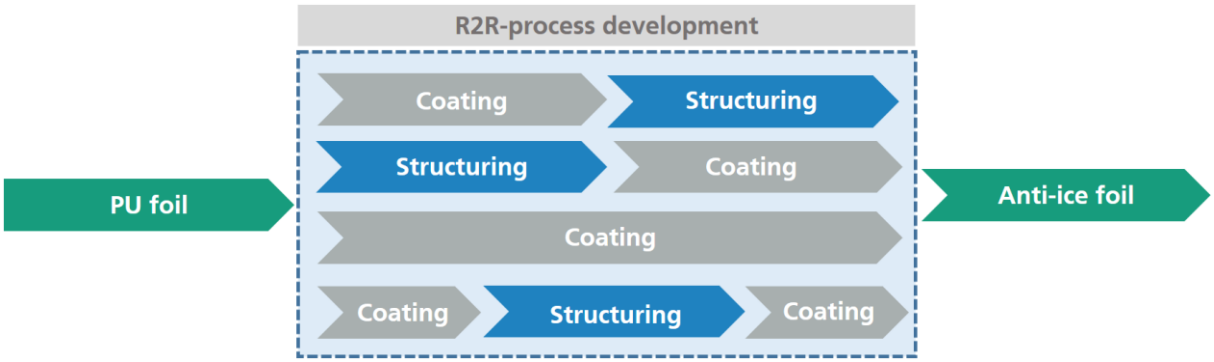

Figure 1: Possible production routes from a commercial PU-foil to a customized anti-ice foil.