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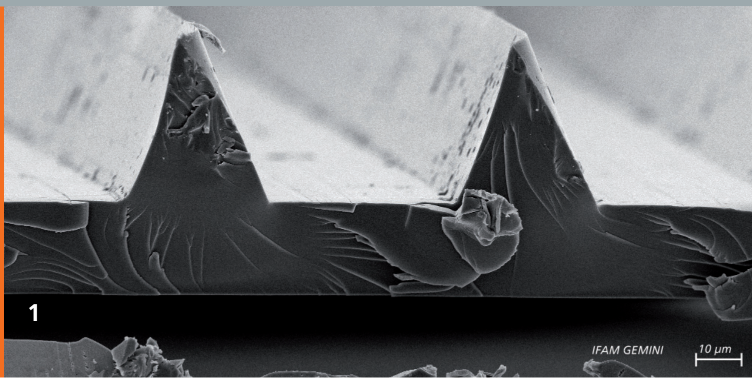

1 *Scanning electron micrograph of a riblet-structured coating surface.*

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LOW-DRAG SURFACE VIA INNOVATIVE COATING SYSTEMS – SHARKSKIN EFFECT FOR LARGE STRUCTURES

Riblets

The scales of fast-swimming sharks have microscopic grooves, so-called riblets, in the longitudinal direction. Fluid dynamic studies in the 1990s (carried out by DLR, Berlin) elucidated the mechanism: In a turbulent flow these microscopic grooves suppress the turbulent components transverse to the direction of flow.

Lower operating costs – Greater efficiency and improved environmental protection

The innovative surface structure – riblet – has special benefits for large objects (Fig. 1): For example, a low-drag coating decreases the fuel consumption of planes and ships up to 3 percent.

Riblet technology

The riblet technology developed at Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM for producing functional surfaces on large objects such as aircraft and ships comprises

- the coating system and
- the application unit.

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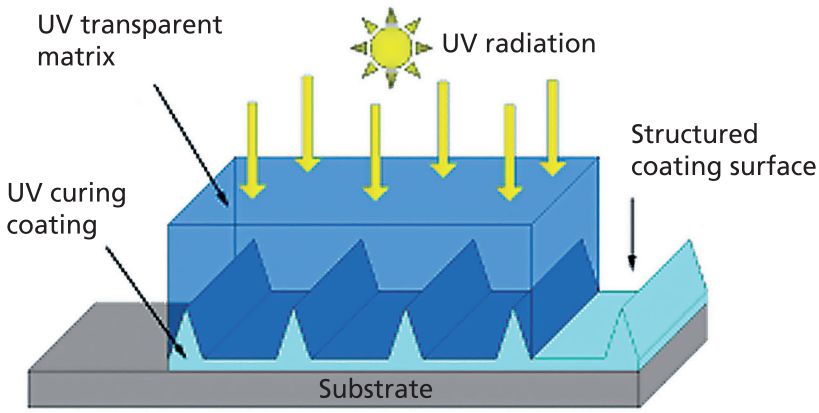


The coating system

Fraunhofer IFAM has developed a coating system that combines the advantages of two different curing reactions. On the one hand, for processing reasons, the material must cure via UV light and must not contain volatile solvents. On the other hand, the coating must also meet the high requirements for the surfaces of aircraft and ships.

These two special needs led to the development of a dual-cure coating which partially cures by UV light and partially chemically crosslinks at room temperature. The selected raw materials and quantities have a major effect on the final properties of the coating. The coating system that has been developed is resistant to soiling, UV stable, and, due to the nanoparticles, it is highly resistant to abrasion and erosion.

The application unit

In order to generate a microstructured coating system, a special application process was developed: This simultaneous embossing-curing method (Fig. 2) allows the microstructure to be accurately transferred to the coating. The process involves curing the coating via UV light through a silicone film which bears the negative of the riblet structure. Thereafter the silicone film is removed.

In order to be able to use this method on large structures, a continuous application method was developed at Fraunhofer IFAM (Fig. 3). It can be applied automatically using a robot.

The system consists of

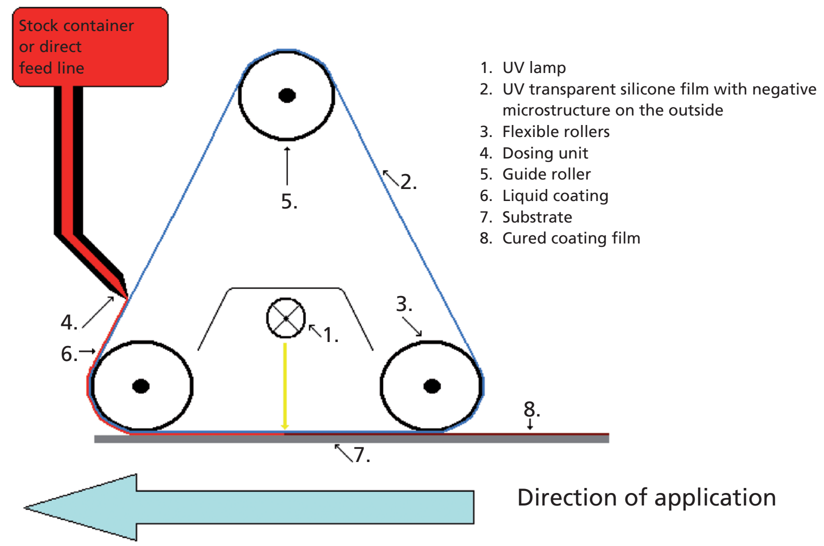
- a seamless rotating silicone mold bearing the negative microstructure,
- a centrally positioned UV lamp, as used in the printing ink industry,
- a coating dosing unit with a wide slit nozzle specially developed at Fraunhofer IFAM which allows the liquid coating to be homogenously applied to the silicone mold,
- two flexible rollers and
- a guide roller.

The application unit is driven over the substrate and leaves behind a cured, coating film with a riblet structure.

The application rate to produce the microstructured coating film is currently 1 square meter per minute. This rate will be increased in the future.

Results

The wall friction resistance can be reduced up to 8 percent for structured coating systems produced by using the process developed at Fraunhofer IFAM.



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2 *Principle of the application.*

3 *Principle of the applicator for continuous application of the coating.*