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Self-lubricating icephobic elastomer coating (SLIC) for ultralow ice adhesion with enhanced durability

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ABSTRACT

A durable, self-lubricating icephobic elastomer coating (SLIC) was realized by systematic optimization of silicone oil infusion levels within a robust, weather-resistant silicone elastomer matrix for ultra-low ice adhesion, targeting high durability levels for a variety of applications operating in harsh icing environments such as in aviation. This coating combines multiple properties that synergistically enhance the ice release effect, i.e., hydrophobicity, low surface roughness, coating elasticity and lubrication enabled interfacial slippage. Supercooled drop impact icing experiments on rotating fan blades at RPMs of same order of magnitude as commercial aircraft engines showed that the SLIC repeatedly reduced more ice on the coating than other commercial hydrophobic and superhydrophobic surfaces. In addition, the SLIC displayed long-term self-replenishing lubrication – after repeated mechanical abrasion of the surface, lubricants stored within the bulk of the coating could continuously migrate to the surface to replace the lost lubricants, thus promoting low ice adhesion. Durability tests also showed that the SLIC could withstand long-term micron-sized droplet impact at 25 m/s and