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Ice Formation Delay on Penguin Feathers ELAHEH ALIZADEH-BIRJANDI, FARYAR TAVAKOLI-DASTJERDI, Department of Mechanical and Aerospace Engineering UCLA, JUDY ST. LEGER, SeaWorld Parks and Entertainment, STEPHEN H. DAVIS, Department of Engineering Sciences and Applied Mathematics Northwestern University, JONATHAN P. ROTHSTEIN, Department of Mechanical and Industrial Engineering University of Massachusetts, Amherst, H. PIROUZ KAVEHPOUR, Department of Mechanical and Aerospace Engineering UCLA — Antarctic penguins reside in a harsh environment where air temperature may reach -40 °C with wind speed of 40 m/s and water temperature remains around -2.2 °C. Penguins are constantly in and out of the water and splashed by waves, yet even in sub-freezing conditions, the formation of macroscopic ice is not observed on their feathers. Bird feathers are naturally hydrophobic; however, penguins have an additional hydrophobic coating on their feathers to reinforce their non-wetting properties. This coating consists of preen oil which is applied to the feathers from the gland near the base of the tail. The combination of the feather's hydrophobicity and surface texture is known to increase the contact angle of water drops on penguin feathers to over 140 ° and classify them as superhydrophobic. We here develop an in-depth analysis of ice formation mechanism on superhydrophobic surfaces through careful experimentations and development of a theory to address how ice formation is delayed on these surfaces. Furthermore, we investigate the anti-icing properties of warm and cold weather penguins with and without preen oil to further design a surface minimizing the frost formation which is of practical interest especially in aircraft industry.

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