World Academy of Science, Engineering and Technology
International Journal of Materials and Metallurgical Engineering
Vol:18, No:07, 2024

Wetting Features of Butterflies Morpho Peleides and Anti-icing Behavior

Authors : Burdin Louise, Brulez Anne-Catherine, Mazurcyk Radoslaw, Leclercq Jean-louis, Benayoun Stéphane

Abstract : By using a biomimetic approach, an investigation was conducted to determine the connections between morphology and wetting. The interest is focused on the Morpho peleides butterfly. This butterfly is already well-known among researchers for its brilliant iridescent color and has inspired numerous innovations. The intricate structure of its wings is responsible for such color. However, this multiscale structure exhibits a multitude of other features, such as hydrophobicity. Given the limited research on the wetting properties of Morpho butterfly, a detailed analysis of its wetting behavior is proposed. Multiscale surface topographies of the Morpho peleides butterfly were analyzed using scanning electron microscope and atomic force microscopy. To understand the relationship between morphology and wettability, a goniometer was employed to measured static and dynamic contact angle. Since several studies have consistently demonstrated that superhydrophobic surfaces can effectively delay freezing, icing delay time the Morpho's wings was also measured. The results revealed contact angles close to 136°, indicating a high degree of hydrophobicity. Moreover, sliding angles (SA) were measured in different directions, including along and against the rolling-outward direction. The findings suggest anisotropic wetting. Specifically, when the wing was tilted along the rolling outward direction (i.e., away from the insect's body) SA was about 7°. While, when the wing was tilted against the rolling outward direction, SA was about 29°. This phenomenon is directly linked to the butterfly's survival strategy. To investigate the exclusive morphological impact on anti-icing properties, PDMS replicas of the Morpho butterfly were obtained. When compared to flat PDMS and microscale textured PDMS, Morpho replications exhibited a longer freezing time. Therefore, this could be a source of inspiration for designing superhydrophobic surfaces with anti-icing applications or functional surfaces with controlled wettability.

Keywords : biomimetic, anisotropic wetting, anti-icing, multiscale roughness
Conference Title : ICSEA 2024 : International Conference on Surface Engineering and Applications
Conference Location : Zurich, Switzerland
Conference Dates : July 29-30, 2024