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Biomimetic thermal barrier coating in jet engine to resist volcanic ash deposition

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The threat of volcanic ash to aviation safety is attracting extensive attention when several commercial jet aircraft were damaged after flying through volcanic ash clouds from the May 1980 eruptions of Mount St. Helen in Washington, U.S. and especially after the air traffic disruption in 2010 Eyjafjallajökull eruption. A major hazard presented by volcanic ash to aircraft is linked to the wetting and spreading of molten ash droplets on engine component surfaces. Due to the fact ash has a lower melting point, around 1100 ℃, than the gas temperature in the hot section (between 1400 to 2000 ℃), this cause the ash to melt and potentially stick to the internal components (e.g., combustor and turbine blades), this cause the ash to melt and potentially stick to the internal components of the engine creating, substantial damage or even engine failure after ingestion. Here, inspiring form the natural surface of lotus leaf (exhibiting extreme water repellency, known as ‘lotus effect’), we firstly create the multifunctional surface thermal barrier coatings (TBCs) by producing a hierarchical structure with femtosecond laser pulses. In detail, we investigate the effect of one of primary femtosecond laser irradiation process parameter (scanning speed) on the hydrophobicity of water droplets onto the two kinds of TBCs fabricated by electron-beam physical vapor deposition (EB-PVD) and air plasma spray (APS), respectively as well as their corresponding to morphology. It is found that, comparison with the original surface (without femtosecond laser ablation), all of the irradiated samples demonstrate more significant hydrophobic properties due to nanostructuring. On the basis of these preliminary room-temperature results, the wettability of volcanic ash droplets will be analysed at the high temperature to constrain the potential impact of volcanic ash on the jet engines.