students' THINKing

Lighter and Stronger Planes

Bonnie Attard

THE PRICE OF FUEL is a large cost burden on the aerospace industry. A lighter plane means cheaper flights, increased aircraft range, and less environmental pollution. Titanium alloys are replacing steel for components such as landing gear bearings and wing frames to reduce overall weight.

Titanium is still mainly used for static load-supporting structures such as landing gears, and seat and aeroplane frames mainly because, when sliding against other surfaces, the material wears down quickly. It is not ideal for moving parts such as bearings and gears. Hardening the surface can mitigate the problem but current techniques such as plasma nitriding are very expensive. Bonnie Attard (supervised by Dr Ing. Glenn Cassar, in a research collaboration between the Department of Materials and Metallurgy Engineering and the Technion Institute of Technology in Israel) has studied a more economically viable surface hardening process: Powder Immersion Reaction Assisted Coating (PIRAC) nitriding to protect titanium surfaces. The process is simple: components are immersed in an unstable nitride powder and heated in a furnace. The heat decomposes the nitrogen in the powder and forms highly reactive monatomic nitrogen. This reactive nitrogen is absorbed onto the titanium surface and reacts to form titanium nitride—a very hard ceramic compound at the surface that protects the component from being worn down during use.

In her research, Attard found that the PIRAC treatment significantly improved the dry-sliding behaviour of two titanium alloys Ti-6Al-4V (the most commonly used titanium alloy) and Timetal 834 (used in compressors for aeroplane engines) by forming a hard and very adherent ceramic surface layer. This treatment allows the components to handle prolonged usage of moving parts under high pressures. These treatments could increase the uses of titanium alloys in aircraft to reduce weight and cost.

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