Engineers Show How to Inhibit Fractures in Solid Surfaces of Aircraft, Electronic Devices

January 30 2008

Engineers at the University of Massachusetts Amherst have found that a strong electric field can stabilize the surface of metals and other solids that conduct electricity, inhibiting the formation of cracks caused by stress. This innovation could improve the function and reliability of a wide variety of machines including aircraft, electronic devices and medical transplants.

Results of the study, led by Dimitrios Maroudas, a professor of chemical engineering at UMass Amherst, were published in the Jan. 25 edition of *Physical Review Letters*. The research team also includes doctoral student Vivek Tomar and M. Rauf Gungor, a research associate professor.

In metals and other crystalline solids that conduct electricity, stress is generally concentrated on the surface of the material. Stress also builds up at interfaces where two types of material are joined, for example an electronic circuit made of metal and plastic. The UMass Amherst study shows that the action of an electric field, properly applied while a material is under stress, can stabilize the surface or interface, inhibiting the formation of cracks and healing cracks that have already started.

“Traditionally, improving crack resistance has relied on improving the physical properties of the surface through polishing and coating, or strengthening the interfaces,” says Maroudas. “Our study proposes a drastically different approach to improving crack resistance and increasing the lifetime of components and devices.”

The electric field improves crack resistance by causing atoms on the surface of the material to migrate when hit by the flow of electricity or “electron wind,” a process similar to sand grains being blown across a beach. When properly applied, the electric field stabilizes the surface of the stressed solid by transporting material to different areas.

“This finding can have dramatic effects on structures used in modern electronics and nanofabrication technologies,” says Maroudas. “And the broader implications of this work are very exciting. For example, one can consider using magnetic fields for magnetic materials or light for optical materials.”

Source: University of Massachusetts Amherst

Citation: Engineers Show How to Inhibit Fractures in Solid Surfaces of Aircraft, Electronic Devices (2008, January 30) retrieved 24 April 2024 from https://phys.org/news/2008-01-inhibit-fractures-solid-surfaces-aircraft.html