National Aeronautics and
Space Administration

technology solution

Sensors

Atomic Oxygen Fluence Monitor

Predicts durability of spacecraft and components

Scientists at NASA's Glenn Research Center have developed a device for measuring atomic oxygen fluence (accumulated atomic oxygen per area) on spacecraft surfaces. These measurements are important because atomic oxygen slowly erodes exposed surfaces of spacecraft. The device provides designers, researchers, and mission managers with real-time measures they can use to predict the durability and lifetime of spacecraft materials and components. Based on the erosion yield of pyrolytic graphite, the device measures atomic oxygen fluence as a function of time with a linear electrical response. It then provides measures that are representative of multi-year low Earth orbital missions, such as those typically implemented on the International Space Station. In addition to aerospace uses, applications may exist within the semiconductor industry, where atomic oxygen is used to clean and/or remove photoresist and impurities from semiconductor surfaces.

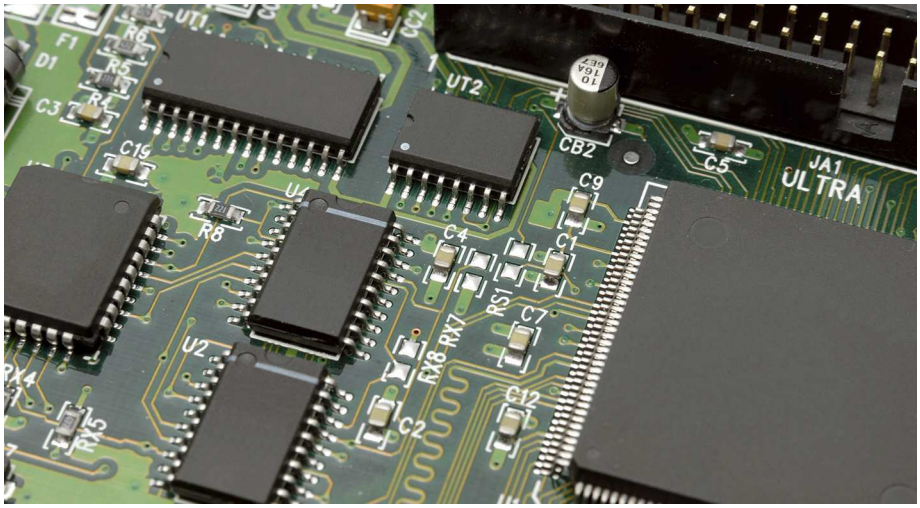
BENEFITS

- Accurate: Linear response and accurate calibration for low-Earth orbit allows accurate prediction of the durability and remaining structural lifetime of spacecraft materials and components
- Robust: The innovation measures the accumulation of atomic oxygen on materials over a period of years
- Simple: Based on the atomic oxygen erosion of pyrolytic graphite and with no moving parts, the device is simpler and lighter than other measurement devices that are based on quartz crystal microbalances

THE TECHNOLOGY

The ability to measure the effects of atomic oxygen on spacecraft surfaces in low Earth orbit has been difficult to achieve. Early devices to measure atomic oxygen fluence consisted of thin films of silver or carbon coatings. NASA Glenn innovators have developed an atomic oxygen fluence monitor that is based on the erosion yield of pyrolytic graphite wedges. As the wedges erode, a greater intensity of light illuminates the photodiode. The advantage of using wedges of pyrolytic graphite rather than measuring the conductivity change of silver, carbon, or semiconductor coatings is that the ratio of the short circuit currents of the sample and reference is a signal that is linear with atomic oxygen fluence and also allows measurement of very high atomic oxygen fluences.

This is an early-stage technology requiring additional development. Glenn welcomes co-development opportunities.



Measuring atomic oxygen fluence can have applications in the semiconductor industry

APPLICATIONS

The technology has several potential applications:

- Spacecraft materials and components
- Plasma treatment in semiconductor manufacturing

PUBLICATIONS

Patent No: 9,255,941

More Information

National Aeronautics and Space Administration

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