In another prior approach — the one leading to the present improved CSPEs — one utilizes a highly-Li\(^+\)-conductive inorganic filler material to increase the effective Li\(^+\)-conductivity of the solid electrolyte. In prior CSPE formulations following this approach, the highly-Li\(^+\)-conductive fillers have been in the form of particles. It has been found that Li\(^+\)-ion conductivity can be increased to about 10\(^4\) S/cm by use of particles, but that the potential for any further increase is limited by the inherently restrictive nature of contacts between particles.

In contrast, in a CSPE of the present type, interparticle contact or the lack thereof is no longer an issue. In a typical application, a CSPE is formed as a film. The preparation of a CSPE film usually involves the formation of a lithium-ion conductor film by electrochemical polymerization on the anode electrode. A CSPE film can be used as an alternative to solid-state electrodes, such as lithium metal or lithium alloy, or as a composite of the lithium-ion conductor film and an electrochemically active material such as lithium metal or lithium alloy. The CSPE film can be made from any material that is capable of conducting Li\(^+\) ions and has a high conductivity for Li\(^+\) ions. The CSPE film can be made by any suitable technique, such as electrochemical polymerization, electrodeposition, or vapor deposition.

This work was done by A. John Appleby, Chunsheng Wang, and Xiangwu Zhang of Texas A\&M University for Glenn Research Center. Further information is contained in a TSP (see page 1).

Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Glenn Research Center, Commercial Technology Office, Attn: Steve Fedor, Mail Stop 4–8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-17470-1.

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**Electrically Conductive Anodized Aluminum Surfaces**

These coatings are highly adherent, transparent, and relatively inexpensive.

*Marshall Space Flight Center, Alabama*

Anodized aluminum components can be treated to make them sufficiently electrically conductive to suppress discharges of static electricity. The treatment was conceived as a means of preventing static electric discharges on exterior satin-anodized aluminum (SAA) surfaces of spacecraft without adversely affecting the thermal-control/optical properties of the SAA and without need to apply electrically conductive paints, which eventually peel off in the harsh environment of outer space. The treatment can also be used to impart electrical conductivity to anodized housings of computers, medical electronic instruments, telephone-exchange equipment, and other terrestrial electronic equipment vulnerable to electrostatic discharge.

The electrical resistivity of a typical anodized aluminum surface layer lies between 10\(^11\) and 10\(^15\) Ω-cm. To suppress electrostatic discharge, it is necessary to reduce the electrical resistivity significantly — preferably to ≤10\(^8\) Ω-cm. The present treatment does this. The treatment is a direct electrodoposition process in which the outer anodized surface becomes covered and the pores in the surface filled with a transparent, electrically conductive metal oxide nanocomposite. Filling the pores with the nanocomposite reduces the transverse electrical resistivity and, in the original intended outer-space application, the exterior covering portion of the nanocomposite would afford the requisite electrical contact with the outer-space plasma.

The electrical resistivity of the nanocomposite can be tailored to a value between 10\(^7\) and 10\(^12\) Ω-cm. Unlike electrically conductive paint, the nanocomposite becomes an integral part of the anodized aluminum substrate, without need for adhesivebonding material and without risk of subsequent peeling. The electrodoposition process is compatible with commercial anodizing production lines.

At present, the electronics industry uses expensive, exotic, electrostatic-discharge-suppressing finishes: examples include silver impregnated anodized, black electrosilichrome, and black copper. In comparison with these competing finishes, the present nanocomposite finishes are expected to cost 50 to 20 percent less and to last longer.

This work was done by Trung Hung Nguyen of EIC Laboratories for Marshall Space Flight Center. Further information is contained in a TSP (see page 1). MFS-32092-1