Environmentally Friendly Conversion Coatings

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Environmental Problem

The use of chemical conversion coatings on aluminum alloys to achieve long-term corrosion resistance of painted spacecraft and aircraft structures has found widespread military and commercial applications. The use of chemical conversion coatings that do not contain harmful chemicals is of particular interest to the U.S. Department of Defense, National Aeronautics and Space Administration, and other federal agencies. At the core of the problem is the demonstration of human health effects associated with exposure to hexavalent chromium. Because hexavalent chromium is a human carcinogen, concern exists not only about workplace exposure at high levels, but also environmental exposure at much lower levels.

This concern has produced a cascade of consequences, including: (1) increased liability for claims of workplace and environmental exposure; (2) increased costs for tracking inventories, monitoring emissions, reporting usage of chromium compounds, and disposal of solid wastes containing chromium; and (3) more stringent disposal limits for discharges of dissolved chromium in wastewater. Therefore, environmentally acceptable alternatives for chromate conversion coatings that exhibit the same corrosion resistance as chromate coatings are needed.

SBIR Technology Solution

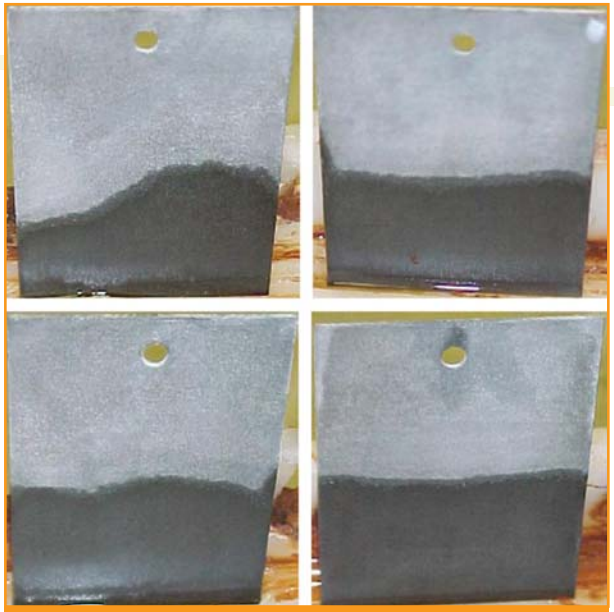
With support from EPA's SBIR Program, Lynntech, Inc., developed a fundamentally new conversion coating based on heteropolymolybdates, which belong to a class of compounds known as polyoxometalates. These species are remarkable for their molecular and electronic structural diversity. The use of heteropolymolybdates represents a significant departure from the use of molybdate ($Mo^{6+}O_4^{2-}$) as a conversion coating.

Tests of coatings prepared from formulations consisting of heteropolymolybdates and several important additives demonstrate exceptional corrosion resistance. Some coatings outperformed the chromate-based conversion coatings in electrochemical corrosion-resistance tests and passed a standard 14-day salt fog test.

The key to this technology is heteropolymolybdates. The primary effect of the hetero atom is an effective transformation of Mo(III) and Mo(IV) to stable Mo(V) and Mo(VI), thereby enhancing the formulation of conversion coatings on aluminum alloys. This unique characteristic provides an elusive self-healing capability. Surface spectroscopic studies indicate the presence of a stable reservoir of Mo(VI) in the oxide layer that acts in an analogous way to Cr(VI).

Commercialization Information

As a result of EPA's SBIR funding, Lynntech has made significant headway towards commercialization of this technology. Lynntech's conversion coatings are designed to be environmentally friendly, which lowers cost by eliminating hazardous waste disposal fees. Lynntech established collaborations with one of the leading aerospace contractors, as well as a leading supplier in the metal finishing

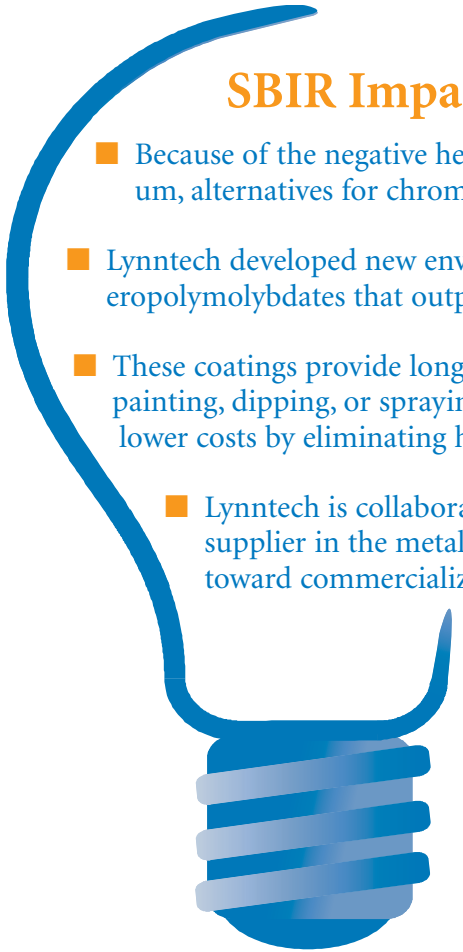


Aluminum 2024-T3 panels prepared with Lynntech conversion coating. No pitting is observed after 336 hours of salt fog spray testing.

industry. Through these collaborations, the company was invited to participate in a national study in search of chromium alternatives funded by the National Center for Manufacturing Sciences. In this study, Lynntech demonstrated two formulations that have the capability and potential to successfully replace chromium-based conversion coatings.

Company History

Lynntech, Inc., incorporated in 1987, is a privately owned technology development company located in College Station, Texas. Lynntech develops scientific and engineering concepts and takes the resulting innovations to the marketplace. The company has a multidisciplinary staff of 153 scientists and engineers. Building on a core area of expertise in electrochemistry, the company has developed products in the emerging markets of fuel cell test systems, proton exchange membrane fuel cells, and electrochemical ozone generation. In addition, Lynntech has successfully spunoff two separate companies in the past year.



SBIR Impact

- Because of the negative health effects associated with hexavalent chromium, alternatives for chromate conversion coatings are needed.
- Lynntech developed new environmentally friendly coatings based on heteropolymolybdates that outperformed chromate-based coatings.
- These coatings provide long-term corrosion resistance; can be applied by painting, dipping, or spraying; are compatible with existing processes; and lower costs by eliminating hazardous waste disposal fees.
- Lynntech is collaborating with a leading aerospace contractor and a supplier in the metal finishing industry to move this technology toward commercialization.