Dow Electronic Materials

Chromium-Free Etch Technology for Plating on Plastic

Dow's Technology for Sustainable Plating on Plastic Manufacturing Enables REACH Compliance Ahead of the Sunset Date

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Plating on Plastics

Dow Develops Chromium-Free Etch for Sustainable Plating on Plastic Manufacturing

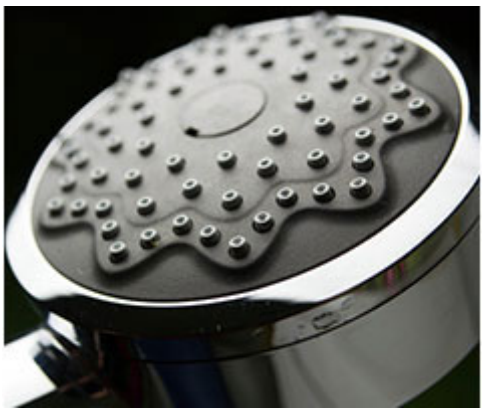
As announced last December, Dow Electronic Materials has developed ECOPOSIT™ CF-800 chromium-free etch (CFE) and the related pre-treatment in response to the regulatory changes affecting the plating on plastic (POP) industry. Our customers who plate acrylonitrile butadiene styrene (ABS) as part of their POP manufacturing work flow now have a way to eliminate the use of hexavalent chromium before the September 21, 2017 sunset date set by REACH.

POP is a challenge because the plastic substrate is nonconductive. In order to achieve good bonding between a plastic substrate and a metallic coating, the POP industry used chromic acid etching for around 50 years. For cost-effective metal electroplating over arbitrarily shaped plastic parts, an electrolessly deposited layer of nickel (Ni) or copper (Cu) would first be put in place to conduct the current across the surface. A chromic acid solution (300-400g/l CrO_3 + 300-400g/l H_2SO_4) was found to consistently and cost-effectively etch ABS surfaces that could then be catalyzed in liquid solutions prior to electroless plating of

high-adhesion metal. The CrO_3 works by oxidative removal of polybutadiene nodules, leading to a rough surface with sub-surface caverns that mechanically anchor plated metal layers.

CrO_3-based adhesion-promotion for ABS was so successful that the process was extended to coating other polymer substrates including PC+ABS and polypropylene (PP). The global plated plastics industry is mature and growing in decorative, sanitary and automotive markets. However, CrO_3 is classified as carcinogenic (IA) and mutagenic (IB), and the REACH Annex XIV calls for an end to the use of the material in just over two years.

Dow Electronic Materials has a long history of invention and innovation in electroplating. Dow Electronic Materials was a pioneer in POP technology development during the 1960s and 1970s with early colloidal catalysts and low temperature electroless nickel products. With the POP industry now concerned with compliance to REACH regulation, the vast expertise of Dow Electronic Materials has been focused on finding manufacturable solutions. After exploring various alternatives over many years, Dow Electronic Materials has shown that trivalent manganese (Mn^{3+}) has similar oxidation “power” to the incumbent etch, and has been able to develop a complete replacement POP process flow using this CFE in standard industrial plating equipment with minimal hardware modifications.



Mn^{3+} is a strong oxidizing agent that has been used since the 1930s for wastewater treatment, for example, and it can be easily regenerated by anodic oxidation. Mn^{3+} is very stable in the specified acid medium, with no decomposition, no disproportionation, and no sludge formation. This new CFE is easily integrated into the POP process sequence, with similar process time and working temperature. In fact, since Mn^{3+} functions in essentially the same way as CrO_3 in etching ABS, with proper integration of catalysts and metal depositions, the peel strength of metal off of surfaces etched with Ecoposit CF-800 are comparable to those etched with chromic acid. The result of this

diligent work was the 2013 granting to Dow a patent for the use of Mn^{3+} as a CFE for POP applications: US 8,603,352.

Dow Electronic Materials is now working with leading customers in different POP end-markets to test and scale-up this new CFE and integrated pre-treatment for high-volume manufacturing (HVM). Due to differences in base plastic materials, moulding parameters, and end-market specifications, fine-tuning is an ongoing process.

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