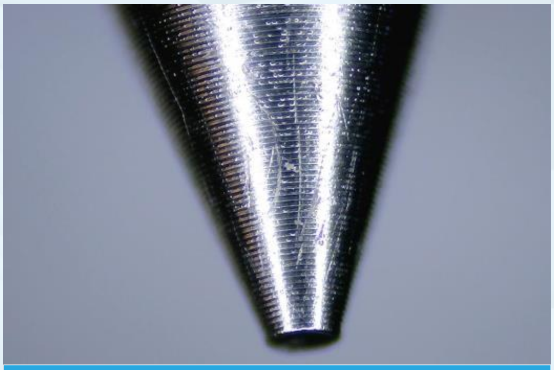
Sustainable Replacement for Toxic Hard Chrome

CIRRUS DOPANT™ PRODUCT INFORMATION

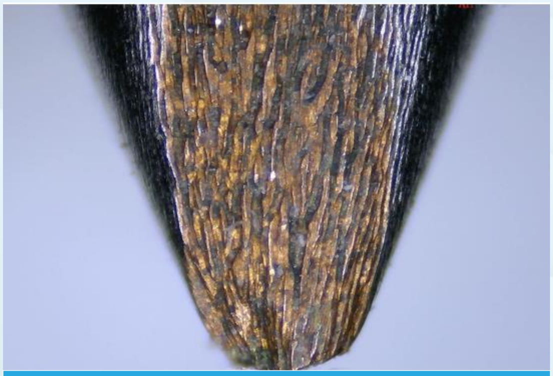
Cirrus Dopant™ technology is a liquid additive for electro-deposited metal coatings that delivers significant additional strength to the surface coating.

Hard chrome plating involves hazardous chrome 6+ carcinogens which impact human health and drive the need to identify viable alternatives. Cirrus Dopant™ is an additive that introduces a ceramic phase secondary material to a plating bath that is stabilised by the electro-chemistry of the bath. No powder-mixing is required, nor handling of nano-particle materials. The stabilised particles will then co-deposit into the metal coating. The particles are uniformly distributed <20 nm in size, and make up <1% of the coating material by weight, creating a composite metal-ceramic matrix structure called a "nano-composite coating".

SIDE BY SIDE FIELD TESTING between Cirrus Dopant™ & standard ENiP was conducted on a 150 ton Arburg injection moulding machine to evaluate Cirrus Dopant™ capabilities. A standard ENiP coating was notbly eroded at 400 cycles, whereas the doped coating showed no wear even after 4000 cycles.



WITH Cirrus Dopant™
ENiP nano-composite coating at 4,000 hours.



WITHOUT Dopant
Standard ENiP coating at 400 hours.

CASE STUDY: INJECTION MOULDING

Hot runner tips are typically surface coated with an electroless nickel phosphorus (ENiP) protection barrier, allowing polymers to be extruded freely without damaging or deforming the substrate. However, with increasing advancements of engineered polymers such as glass additives these tips become progressively eroded, increasing maintenance and replacement costs of hot runner tips. Cirrus Dopant™ is an ideal coating technology that strengthens the structure of the coating.

ADVANTAGES

Cost savings:
Asset life extension of 10x & low capital cost transition

Marketability:
Non-toxic replacement for Cr 6 + applications & exceptionally durable – highly wear resistant

Competitive advantage:
Proprietary technology: Opportunity to be granted an exclusive license position

DEPLOYING PATENTED TECHNOLOGIES TO DELIVER CUSTOMER OUTCOMES THROUGH SUSTAINABLE COATINGS AND NANO-COMPOSITE MATERIALS

CIRRUS MATERIALS SCIENCE

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FEATURES

Dispersion Strengthening

Where particles are small enough, with a regular inter-particle distance, and a high enough volume fraction in the coating, they can prevent dislocations or weaknesses from travelling through the material as it comes under stress. **Cirrus Dopant™ nano-particles are one of the only 'drop-in' technologies** that can achieve this outcome, usually used in super-alloy design. As Cirrus nano-particles are ceramics, the dispersion strengthening effect is not reduced at high temperature.

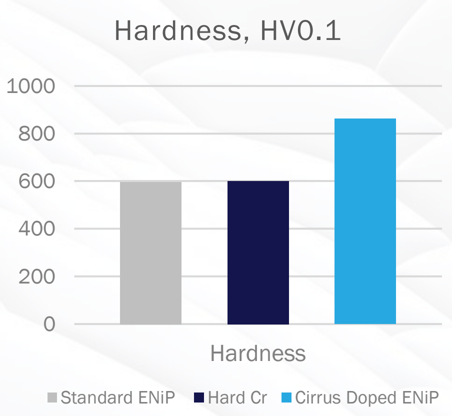
Grain Refinement

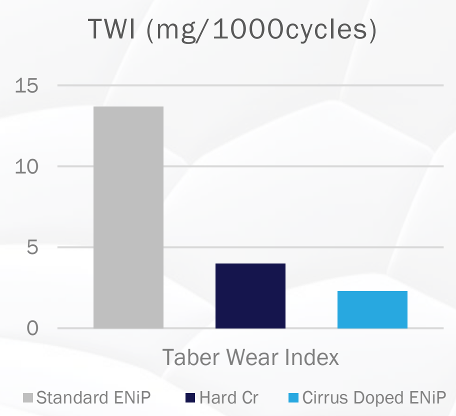
Nano-structured materials are known to provide increased yield strength, increased wear resistance, reduced friction coefficient, and improved fatigue strength, relative to coarse-grained materials. **Cirrus nano-particles form at the grain boundaries as the metal coating deposits, limiting the growth of the grain and increasing the nucleation sites for new grains**. This produces coating materials with a refined grain structure, less porosity and improved ductility.

BENEFITS

- REACh compliant
- Improved mechanical properties such as: high thermal stability, hard-wearing and corrosion resistance
- Low-cost 'drop-in' technology
- Seamlessly integrates secondary particles into metal coatings

HARDNESS & TWI TEST





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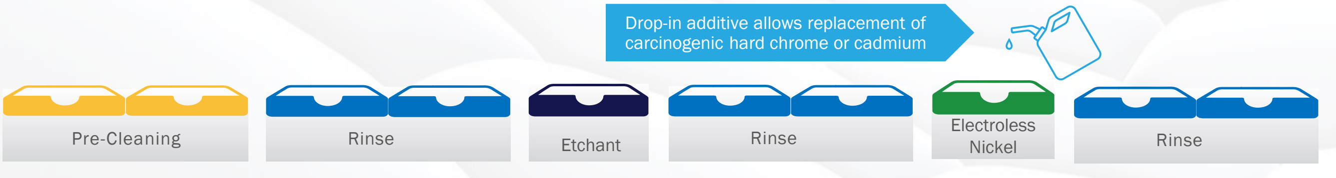
EASY TECHNOLOGY INTRODUCTION

Cirrus Dopant™ nano-composite coatings can be used as a drop-in replacement for carcinogenic materials such as hard chrome or cadmium, or to protect important components against corrosion in heavy wear or high temperature applications.



Cirrus Dopant™ nano-composite coatings are ideal for high-end applications in marine, electronics, aerospace and defence that require exceptionally durable, wear-resistant surfaces as well as functional performance.

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