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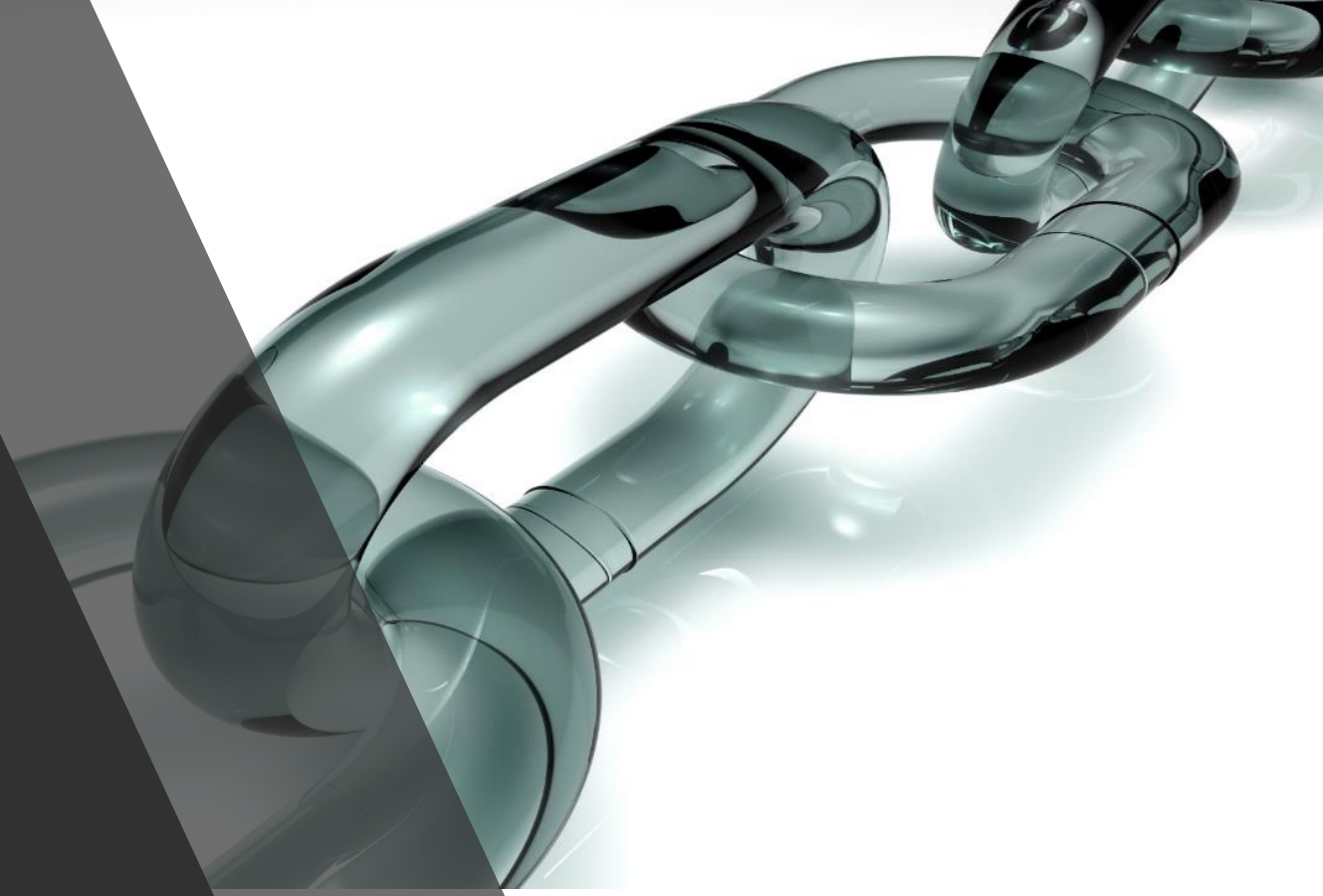
See Leng Tay, PhD | Seeleng.Tay@cirrusmaterials.com

The use of nano-scale Cirrus Dopant™ to Improve Existing Coatings



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Agenda

- **Nano-composite coatings & Cirrus Dopant™**
- **Dopant Science - how it works**
- **Use of Cirrus Dopant™ in different coatings**

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Innovation

Nano-composite Coatings & Cirrus Dopant™

Properties of Nano-composite Coatings

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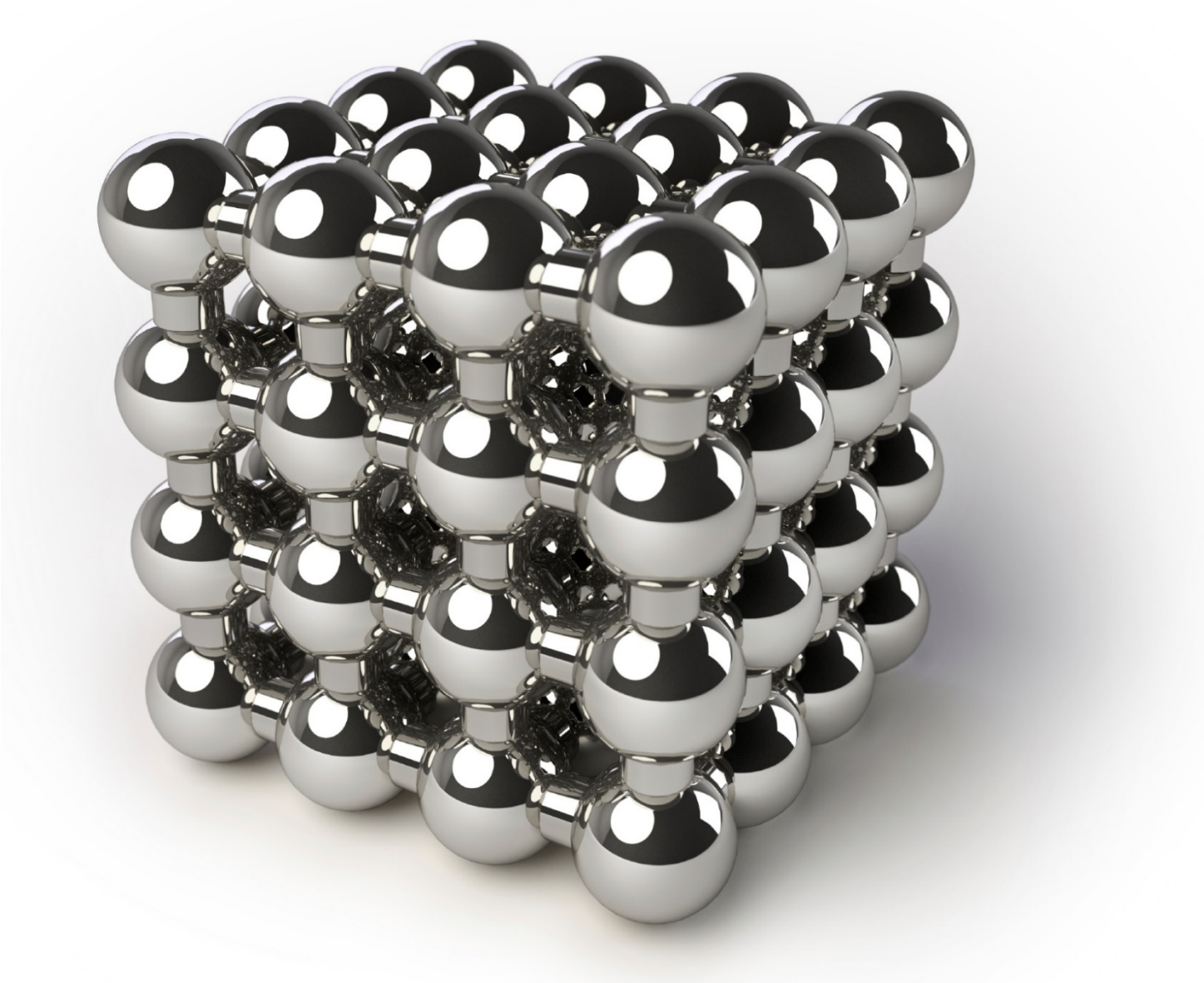
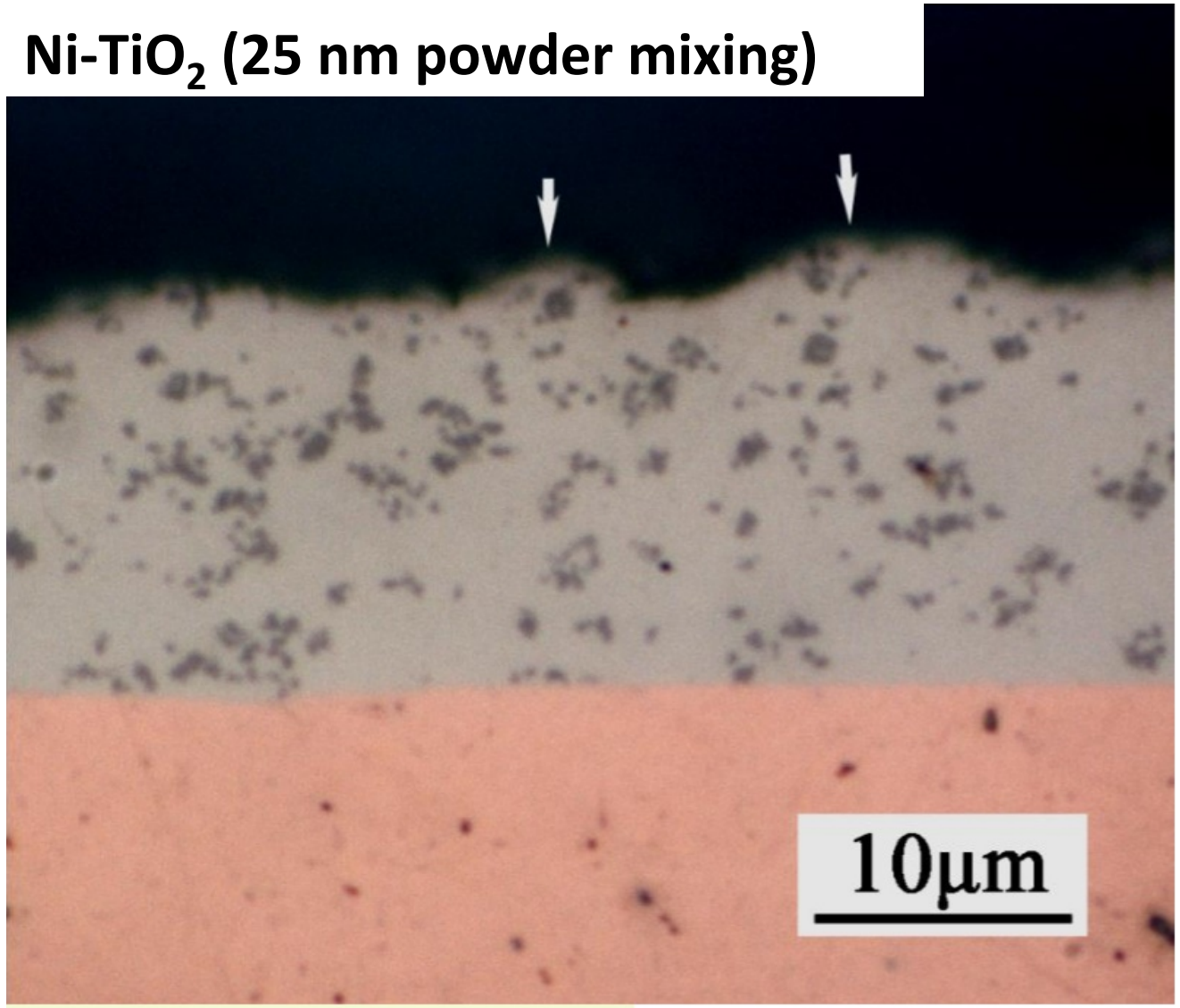
- Multiphase solid material
- 25 -100nm secondary particles
- Superior properties especially in term of mechanical properties



Hard nano-particle mixing

Ni-TiO_2 (25 nm powder mixing)



- Electroplating process
- Issues:
  - Agglomeration & inconsistencies
  - Physical handling of nano-particles

Cirrus Dopant™

- Liquid to liquid – forms sub 20nm particles which do not agglomerate
- Designed to be stable and highly dispersed in the bath
- Safe to handle

Hard-particle mixing v. Cirrus Dopant™

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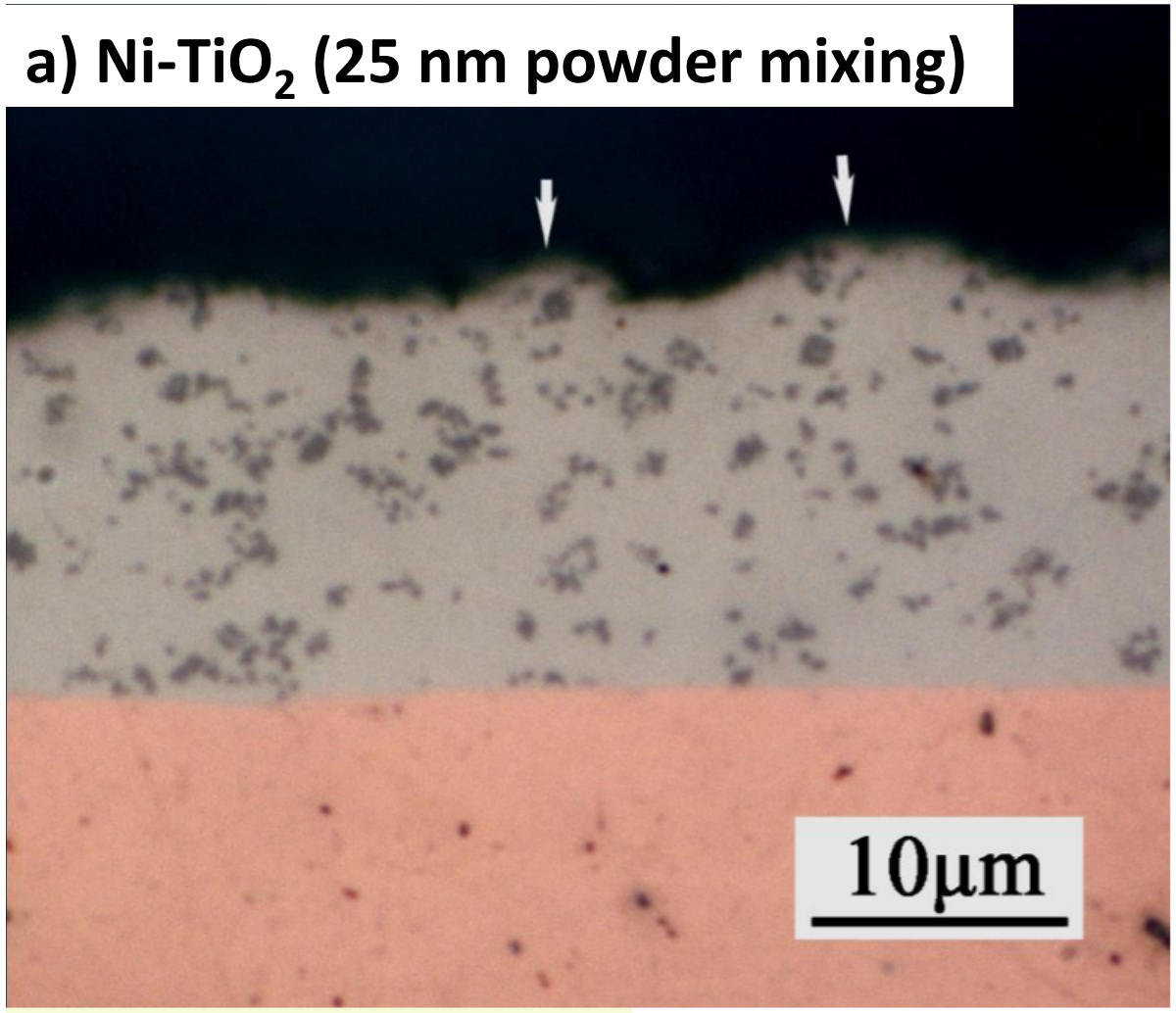

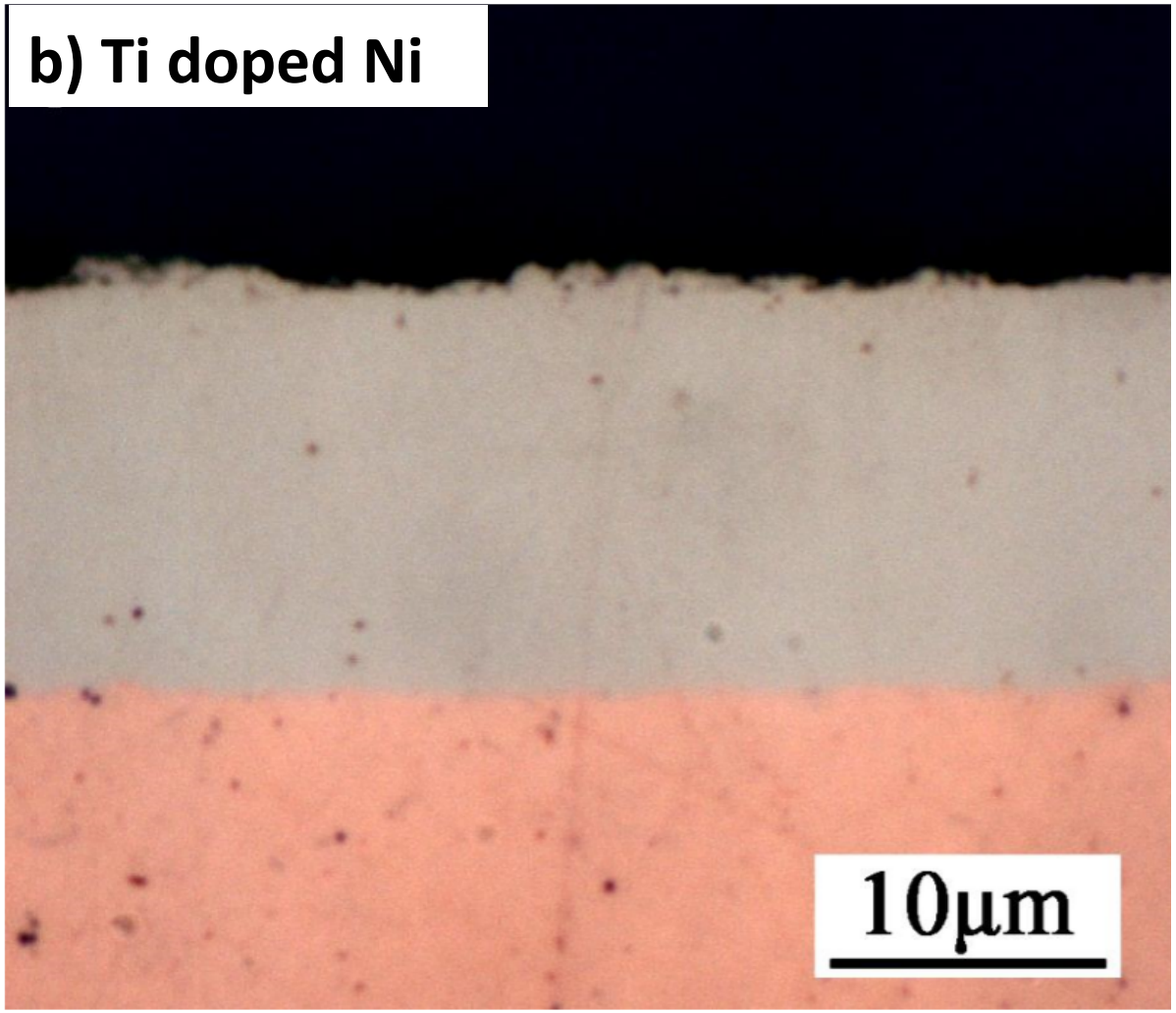

Unlike powder mixing, Cirrus Dopant™ can create an even dispersion of sub 20nm particles throughout the coatin

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Dopant Science

How does Cirrus Dopant™ Work?

Cirrus Dopant™ in the plating bath

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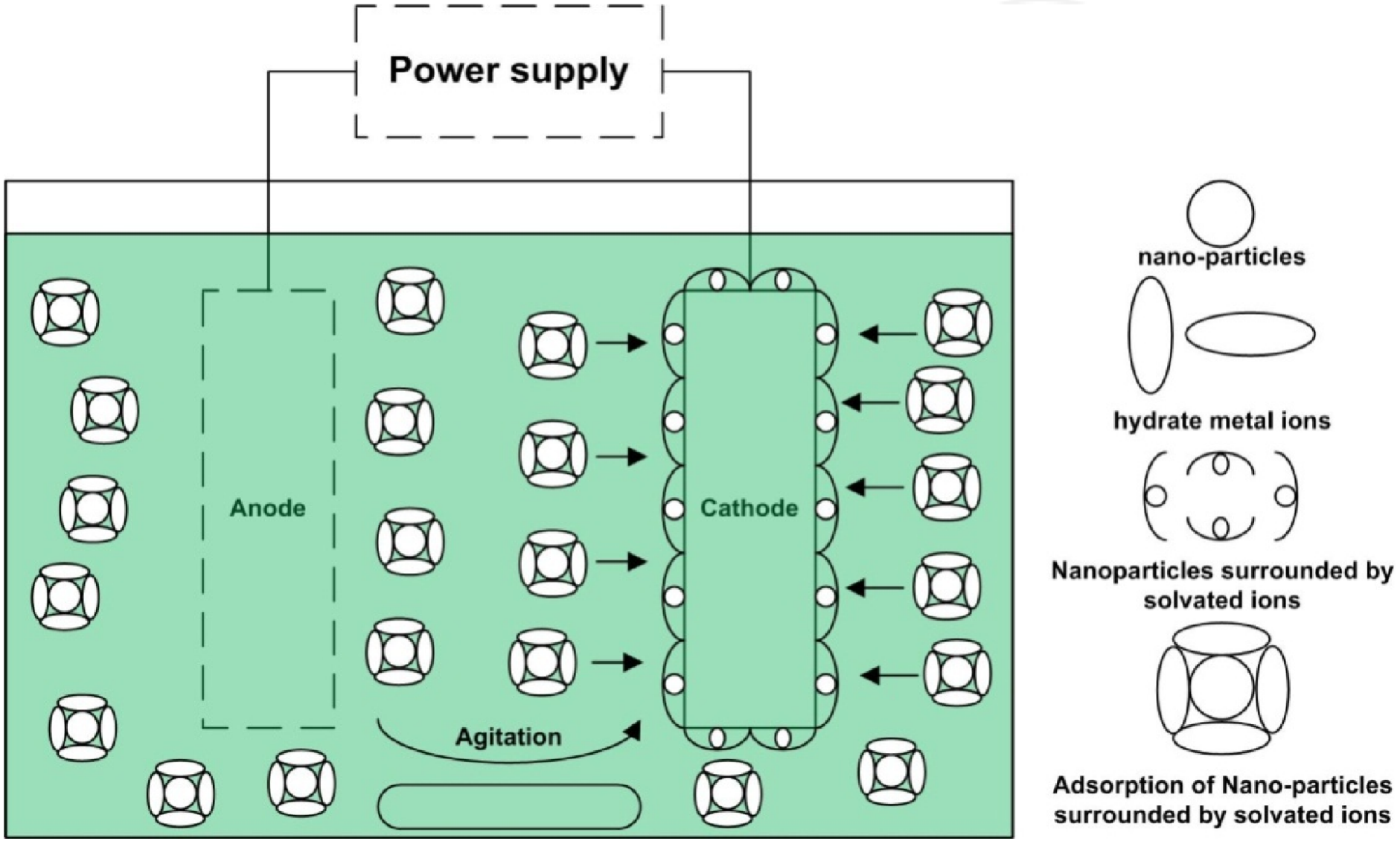
1. In-situ generation of nanoparticles, stabilised by hydrate metal ions
2. Transported by convection diffusion and electrophoreses
3. Adsorbed onto the freshly deposited surface as metal ions reduce



Cirrus Dopant™ Ti particles in Ag coating

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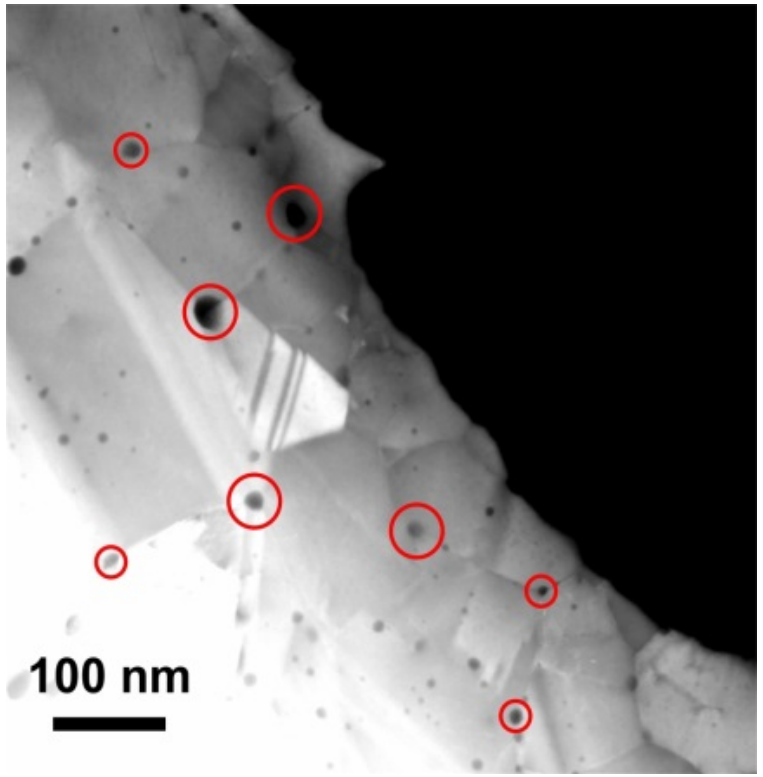
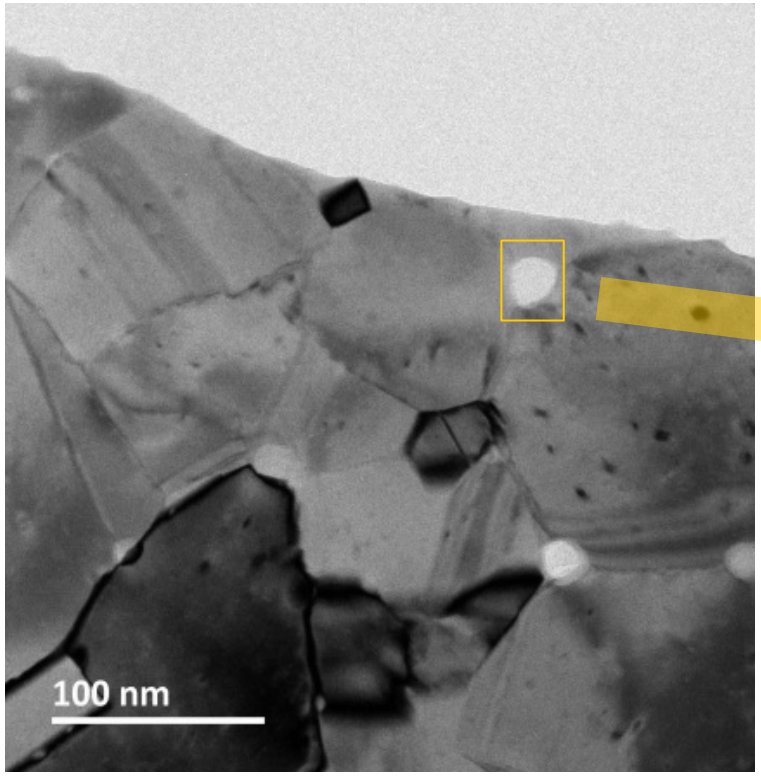
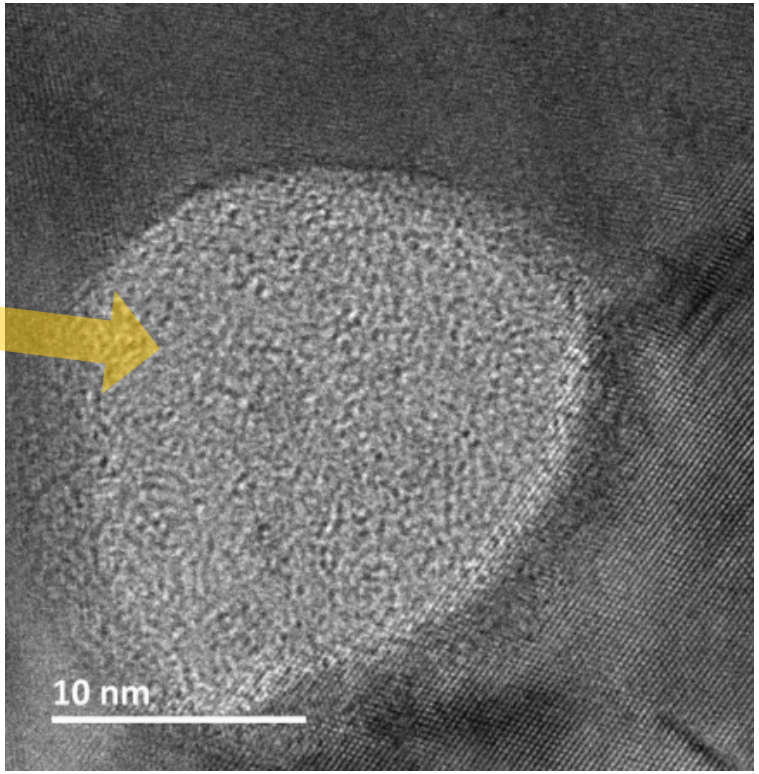
- Uniformly distributed nano scale particles <20nm
- Particles at grain boundaries
- Amorphous particle structure







Strengthening Mechanism

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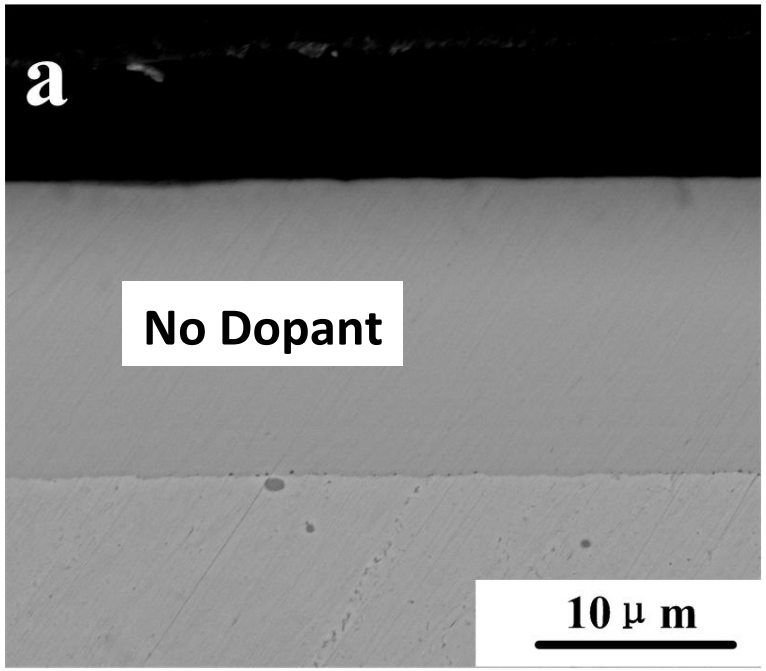
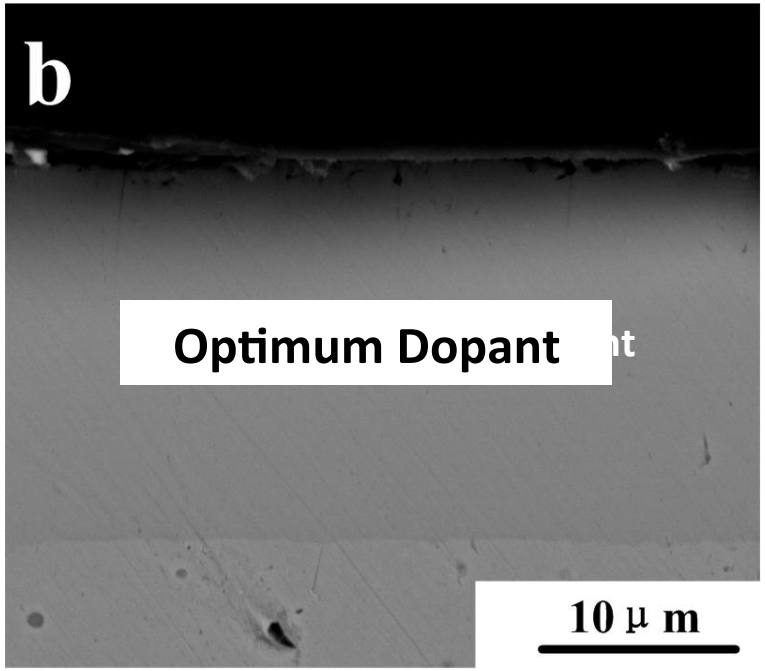
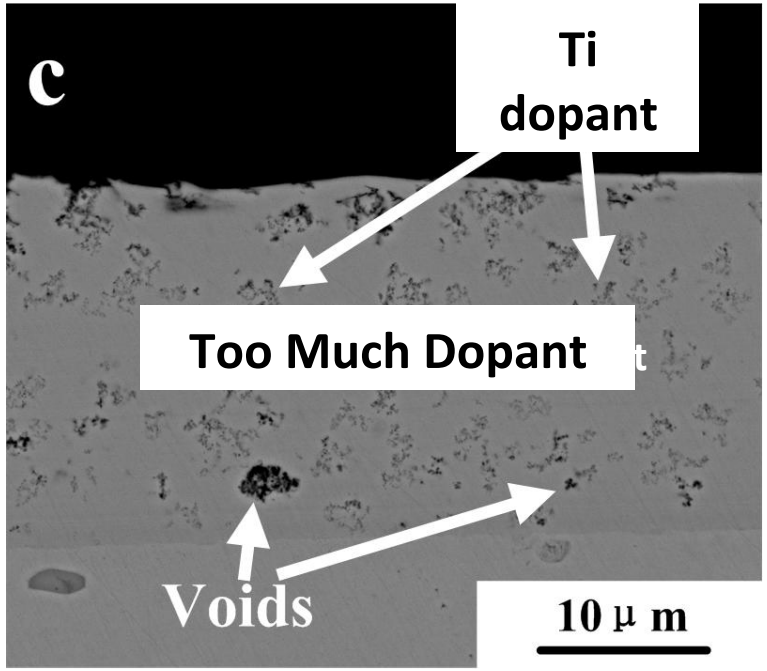
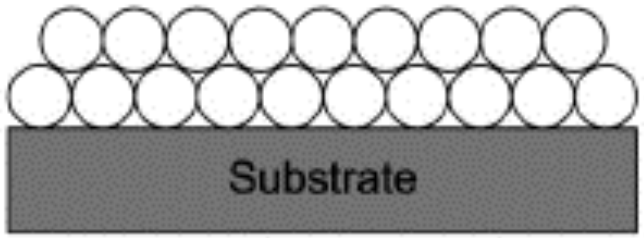
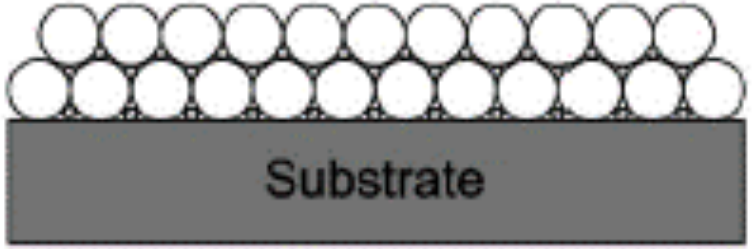
Ti doped NiP coatings

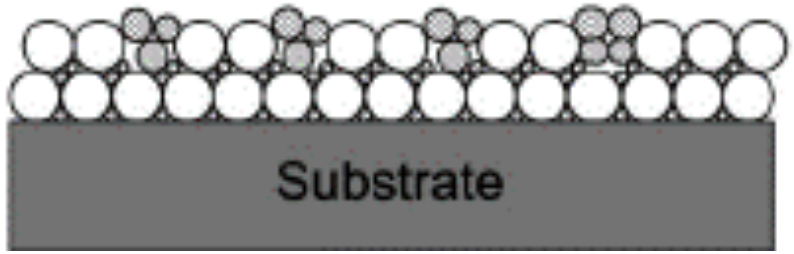




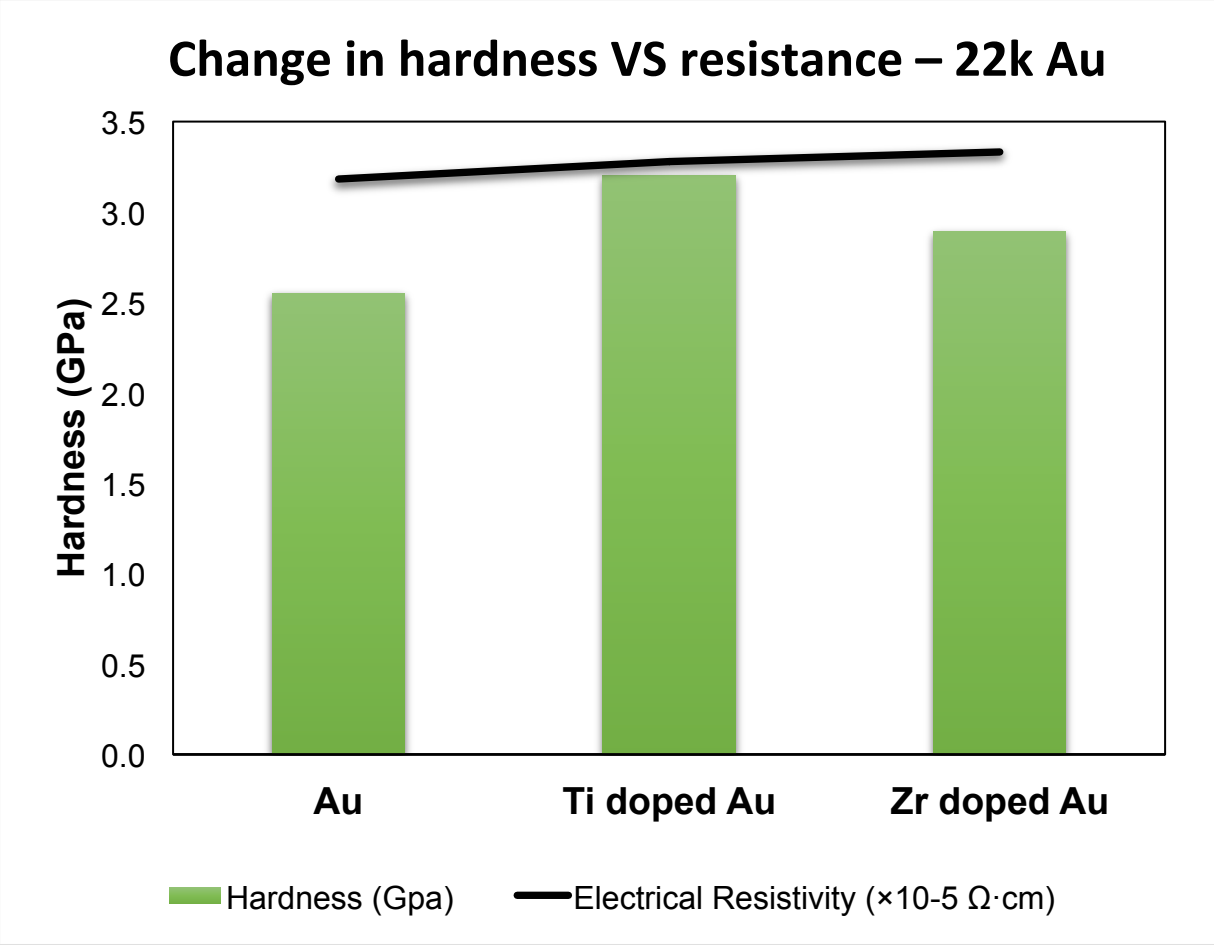


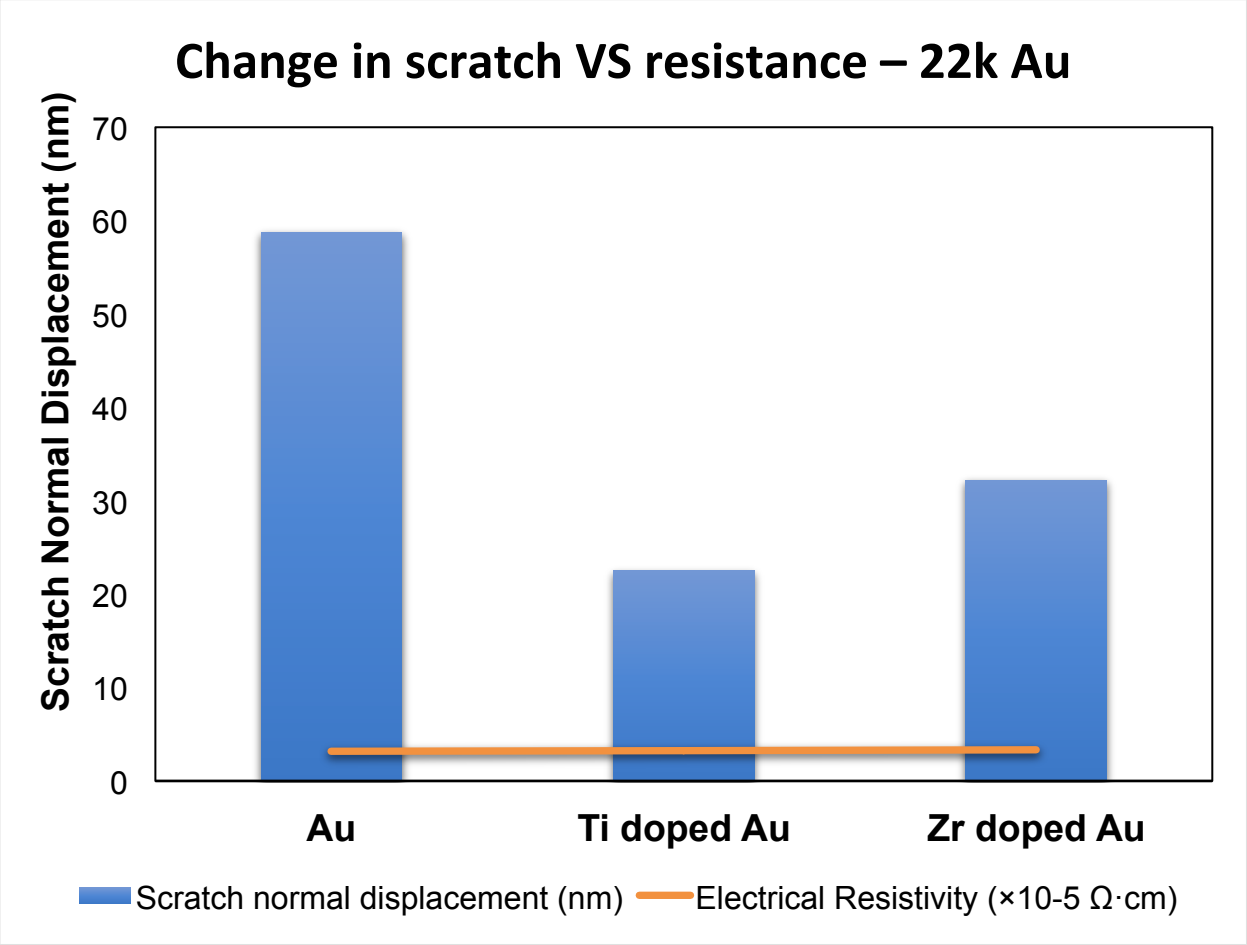






Negligible Impact on Coating Conductivity





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Applications

The use of Cirrus Dopant™
in different coatings.

Hardness Improvement

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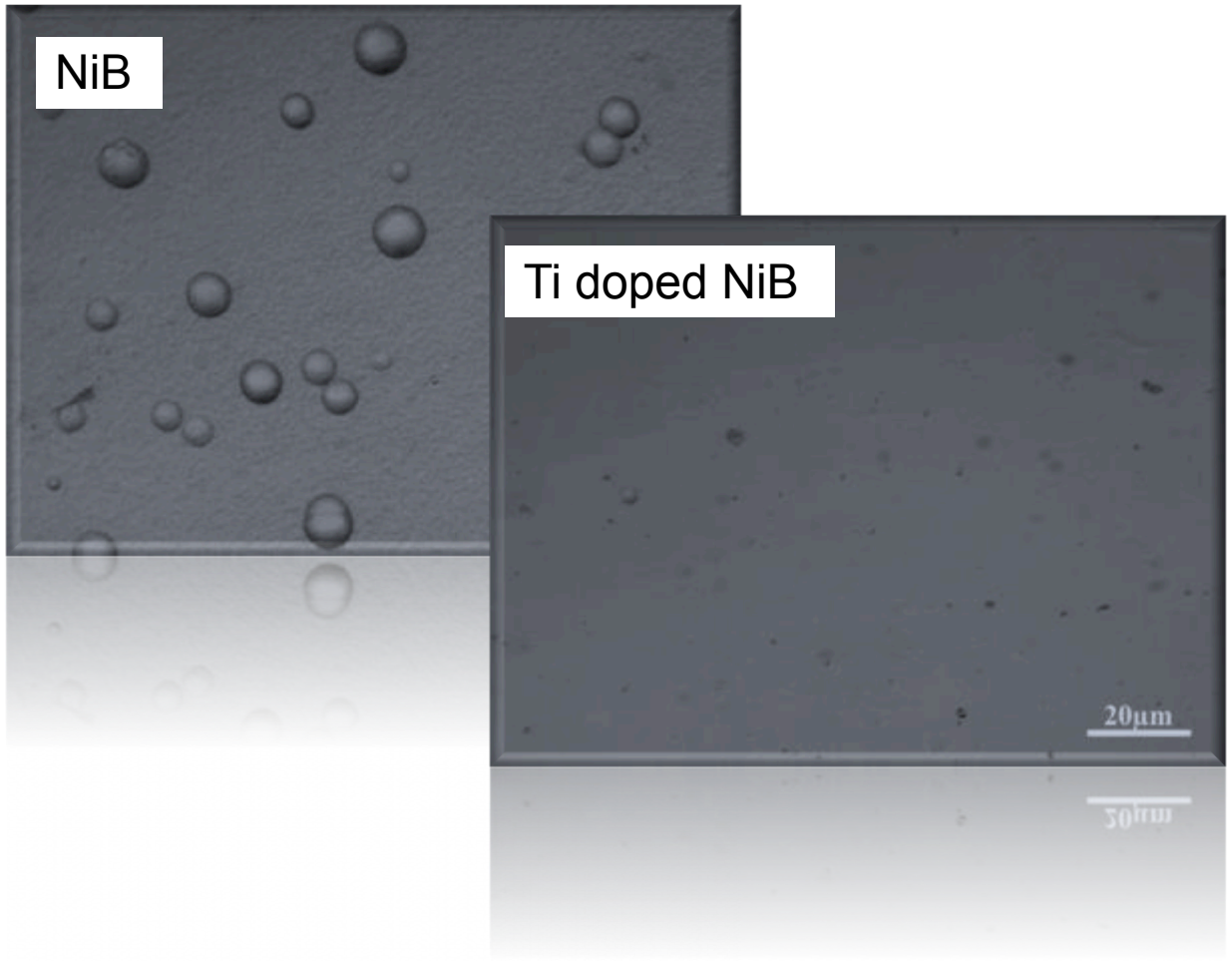

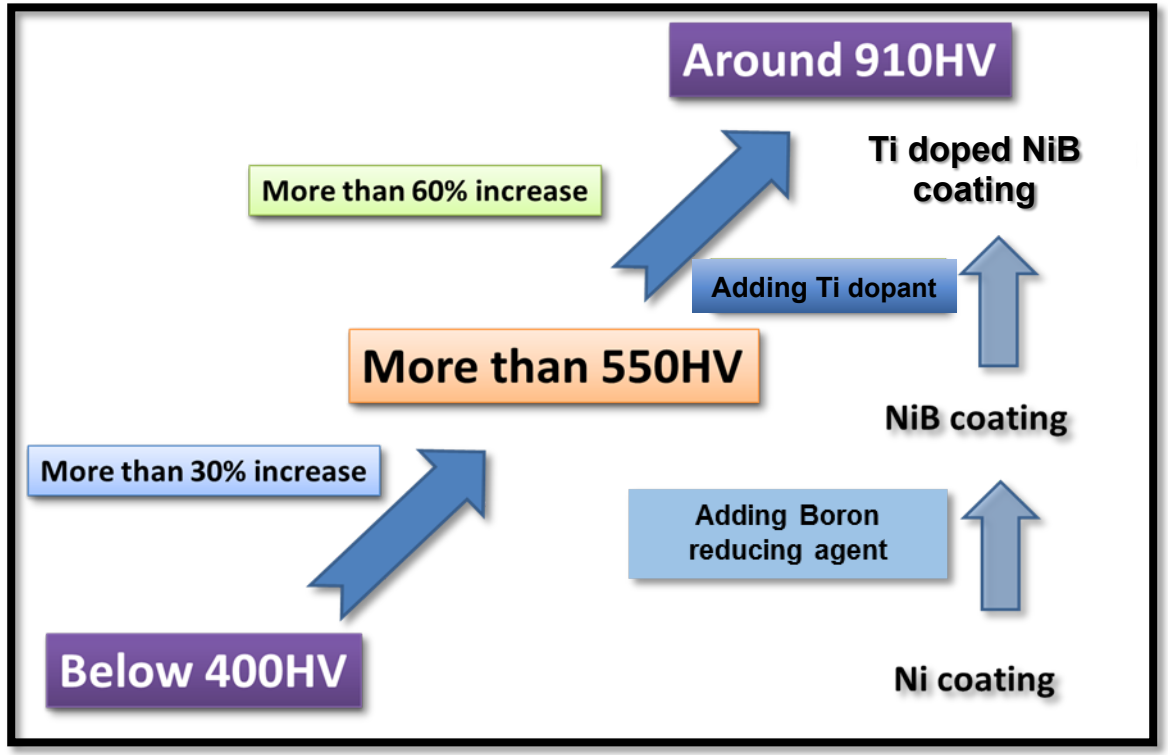

Nickel Boron versus **Cirrus** Ti doped nano-composite Nickel Boron on Mild Steel

Wear Test – Al_2O_3 ball on Cu coating

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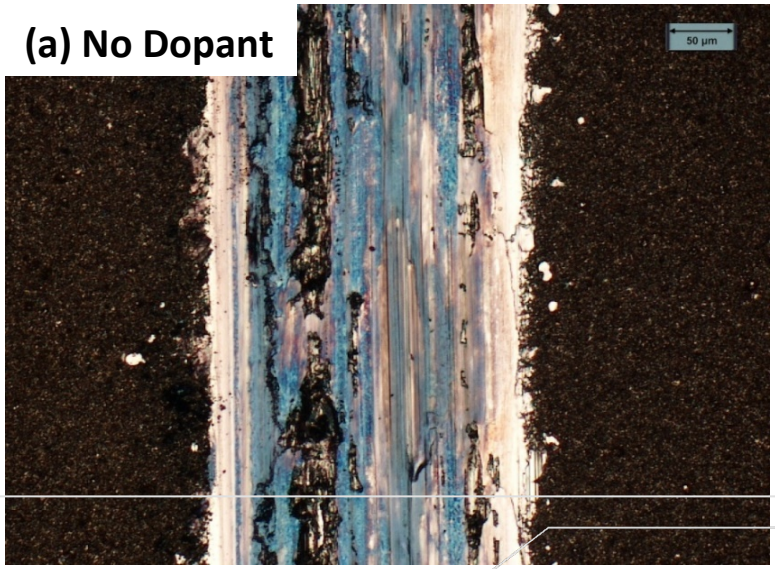

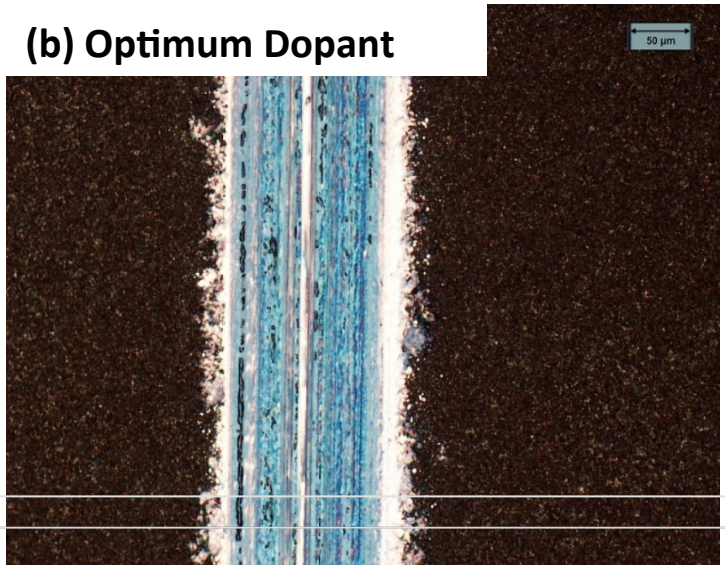

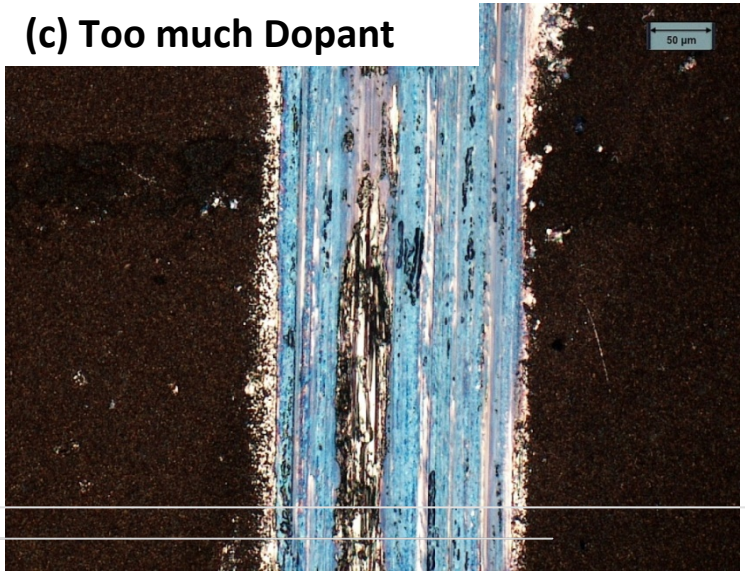

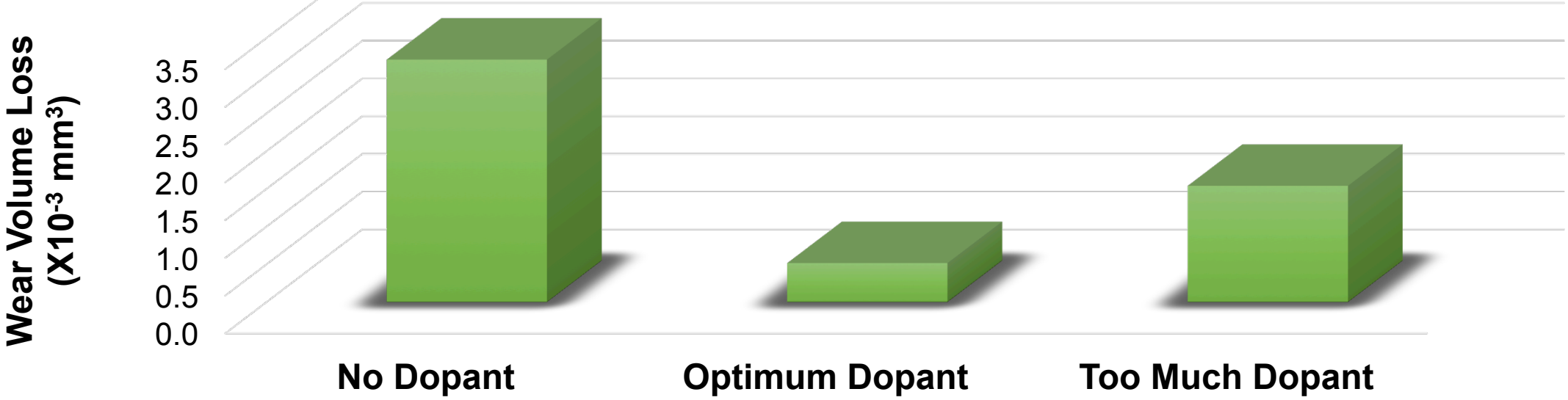

Reduction in Stress and Porosity

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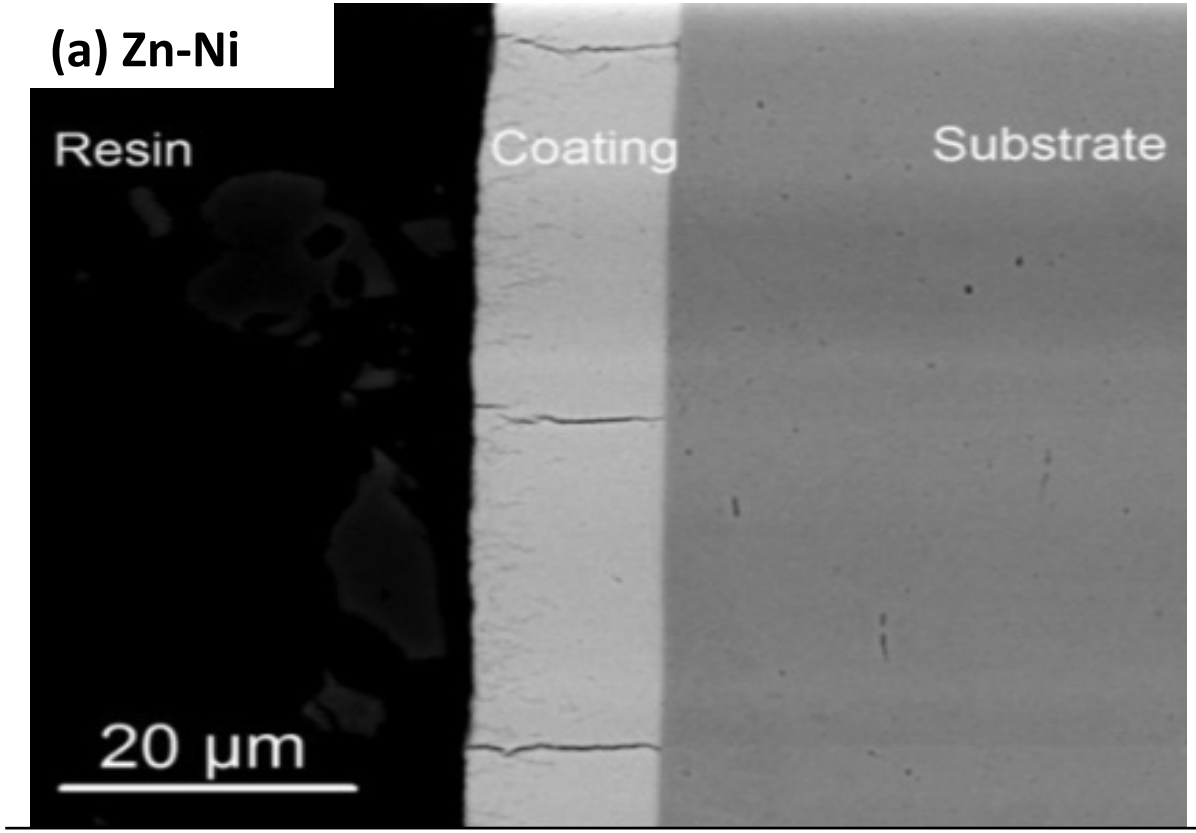

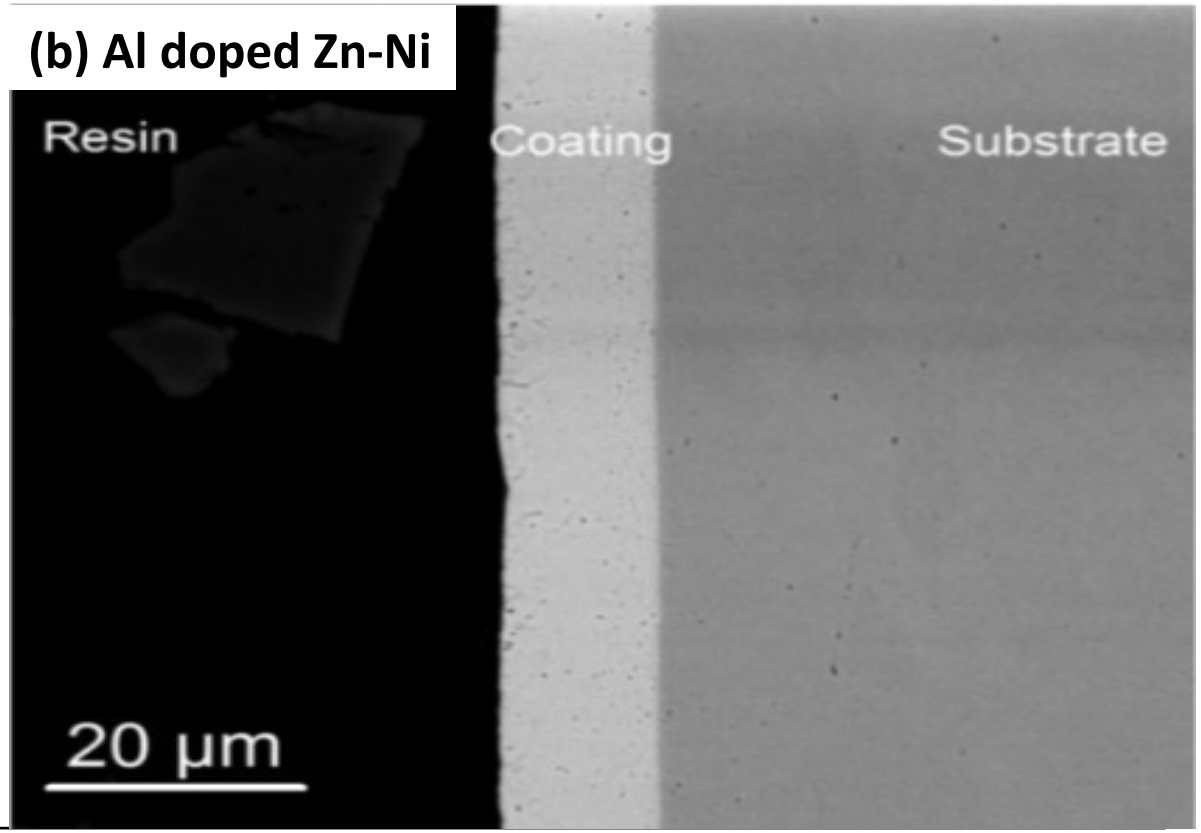

	Corrosion Potential (mv)	Corrosion Current Density (µA/cm^2)
ZnNi	-1048	6.0
Al doped ZnNi	-1013	0.8

Cirrus Dopant™ - Applicability

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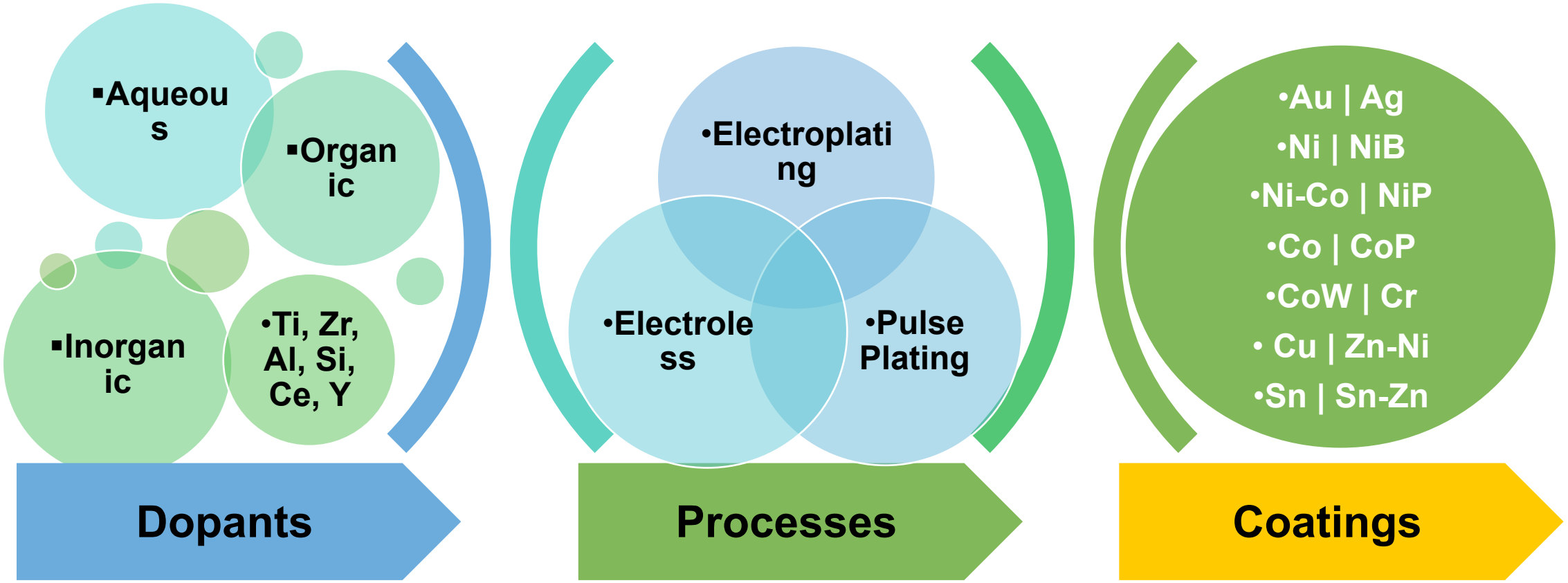

(pH 1 to 14)

Cirrus Dopant™ - Summary

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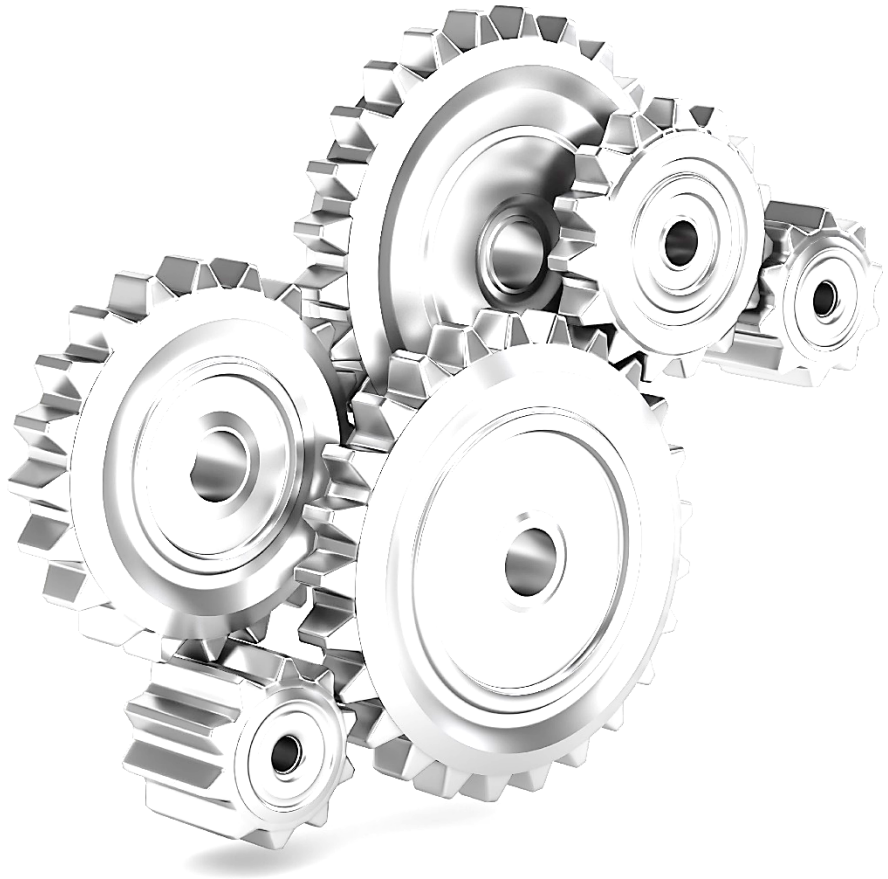

- Nano-composite coatings without handling nano-particles
- Enhanced coatings from electrolytic and electroless baths
- Maintains coating functionality & conductivity
- Applicable to a wide variety of coatings, substrates and finishes

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Thank you

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