Coating for Light Metals
by Kinetic Metallization

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Introduction:

The application of **Aluminium** and **Magnesium** alloys is often limited by poor surface properties – primarily corrosion and/or wear resistance. **Surface treatments** may be used in order to broaden their range of applications. In this work, the **Kinetic Metallization process** is used for producing composite coatings with good bonding and little oxidation.

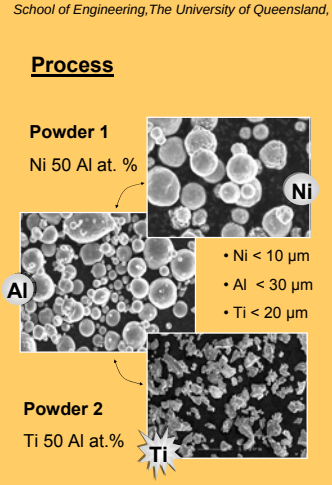
Objectives:

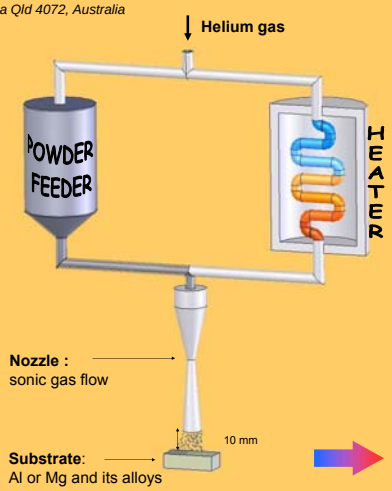
Produce, after annealing, a coating with *low porosity* and *homogenous properties*.

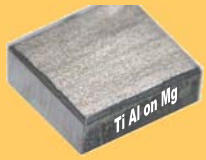
Improve, *corrosion* and *wear* resistance

Form, *intermetallic compounds* at temperatures suitable for light metals.

Process



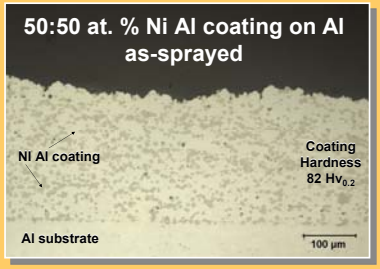


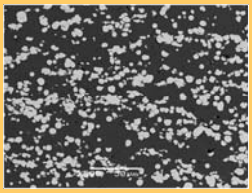


Air cool

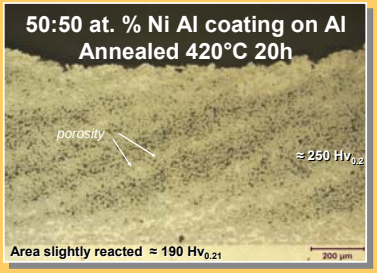
The attractive attributes of **Nickel-Aluminium** and **Titanium-Aluminium** composite coatings such as good environmental resistance, high melting point, low density make them perfect candidates for protective coatings.

Nickel-Aluminium coatings

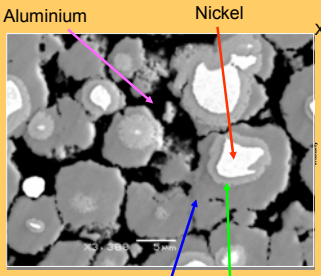


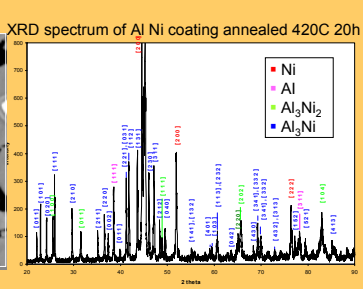


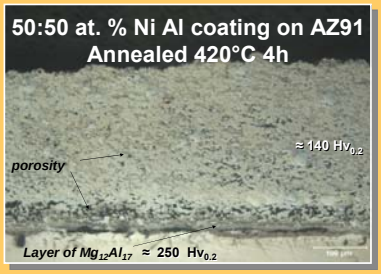
- Homogenous coating
- Low porosity, < 0.5% of the coating area
- Good interface coating/substrate
- Volume fraction of Nickel 30%



- Diffusion of aluminium in the nickel particles
- Formation of porosity due to the diffusion, about 13.21% of the coating area
- Reaction not homogenous, centre of the coating almost fully reacted, top and bottom slightly reacted
- Percentage of pure Nickel (particles unreacted) : 9 %







- Diffusion of aluminium in the magnesium substrate: formation of a layer of $Mg_{12}Al_{17}$ at the interface.
- Emergence of porosity due to the diffusion :
  diffusion Al ⟶ Ni : porosity in the coating
  diffusion Al ⟵ Mg: layer of porosity at the interface
- Percentage of pure Nickel (particles unreacted) : 15 %

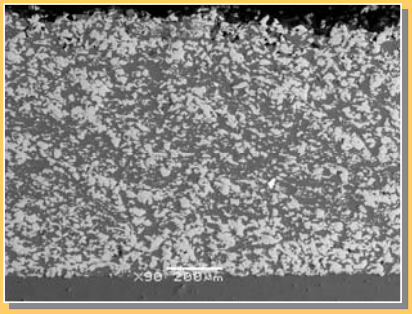
Conclusion

Aluminium Nickel coatings are promising candidates for coating magnesium and its alloys.

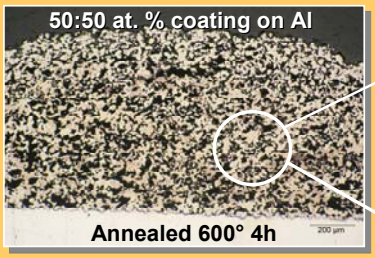
Next objectives

The study is only at its beginning, the rest of this work will focus on corrosion and wear resistance of Ni-Al coatings annealed at different temperatures close to 420°C, and different times to vary the degree of reaction.

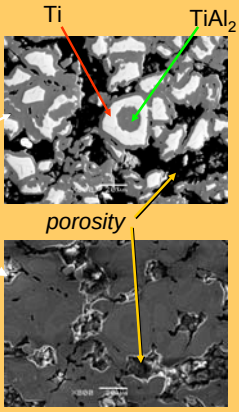
Titanium-Aluminium coatings

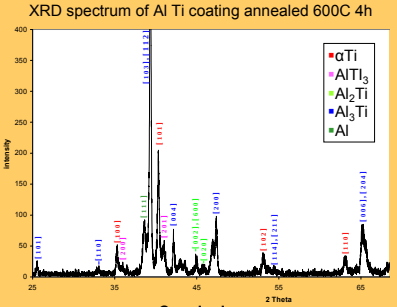


50:50 at. % coating on Al as-sprayed



- Diffusion of aluminium in the titanium particles
- Asymmetrical diffusion leads to Kirkendall effect and formation of porosity





Conclusion

Aluminium-Titanium coatings are not suitable for magnesium substrates, but may be adapted for coating aluminium or titanium alloys.