

Modelling and Predicting High Temperature Coating Damage by Oxidation and Interdiffusion

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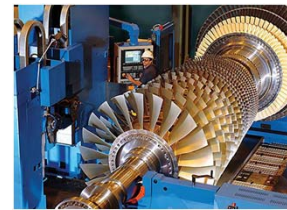
Aeroengines



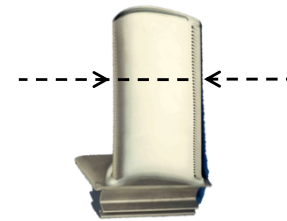
Power Generation



Turbine



Turbine Blade



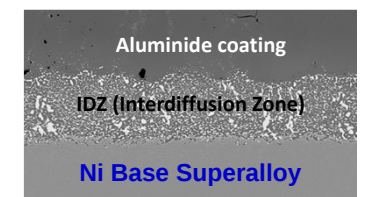
Metallic coatings



MCrAlY coatings



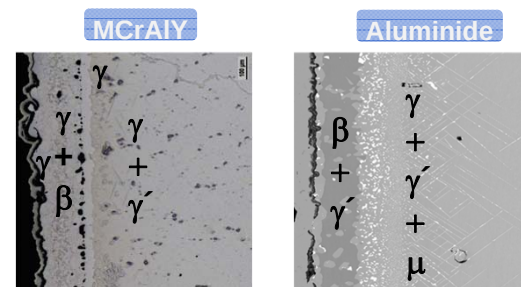
Aluminide coatings



Corrosion resistant protective coatings are required for operation at high temperatures in corrosive gases

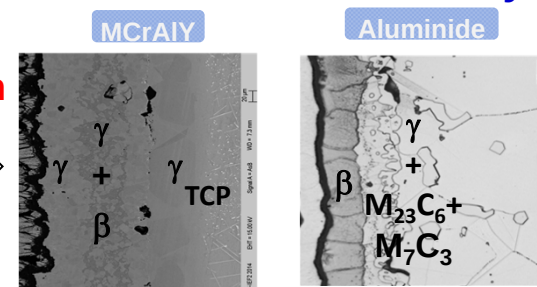
Degradation mechanisms

Chemical lifetime

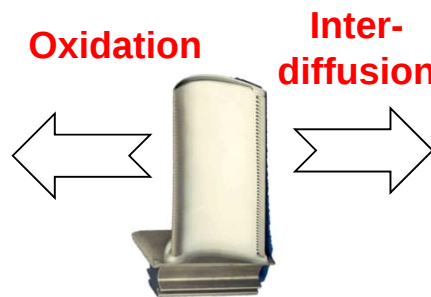


- Depletion of β -NiAl
- Diminishing oxidation resistance

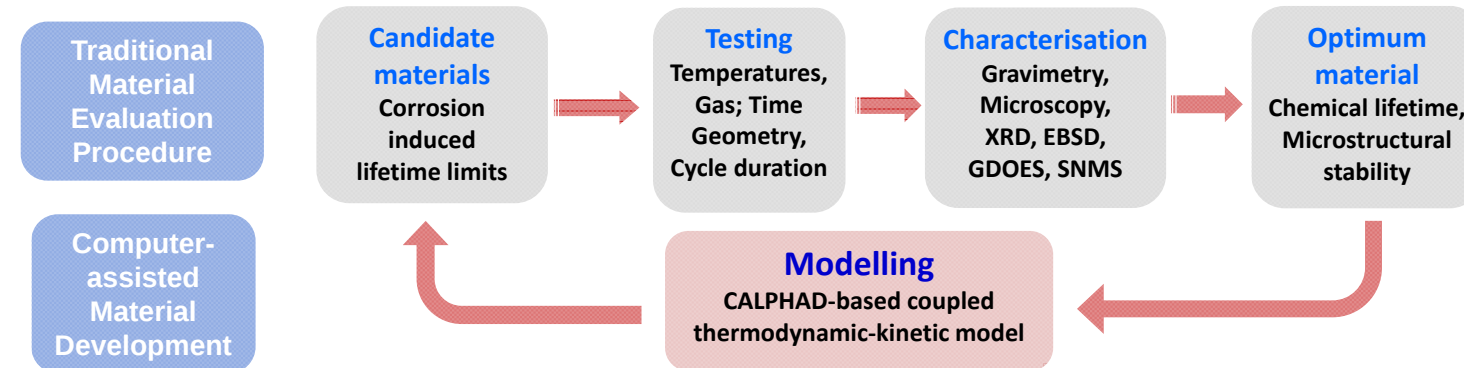
Microstructural stability



- Coating-Substrate compatibility
- Secondary Reaction Zone (precipitates / TCP phases)



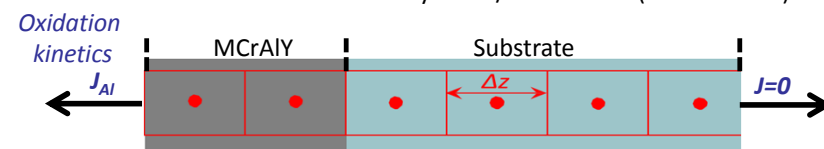
Coating development strategies



Lifetime Assessment of Protective Coatings for Materials in the Aviation & Power Generation Industry with an In-House Developed Code

Pre-processing

- o Discretisation of domain
- o Global/Boundary/Initial conditions
- o Thermodynamic/Kinetic data (Thermo-Calc)



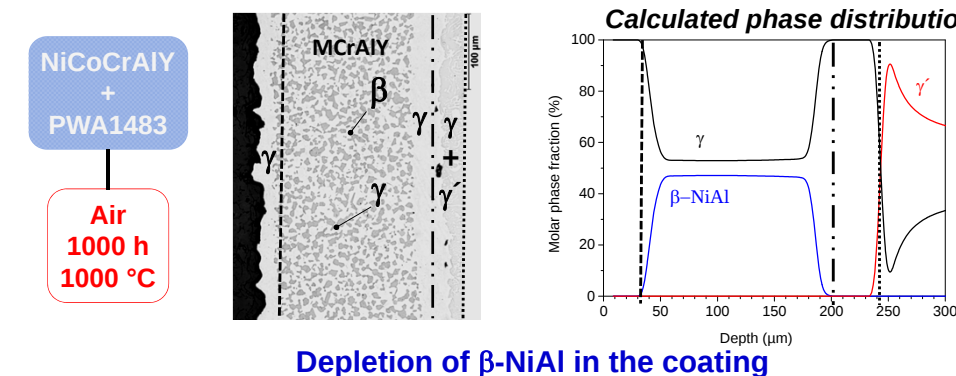
In-house developed code Homogenisation model

- o Calculation of phase equilibria
- o Calculation of element fluxes
- o Modification of mesh

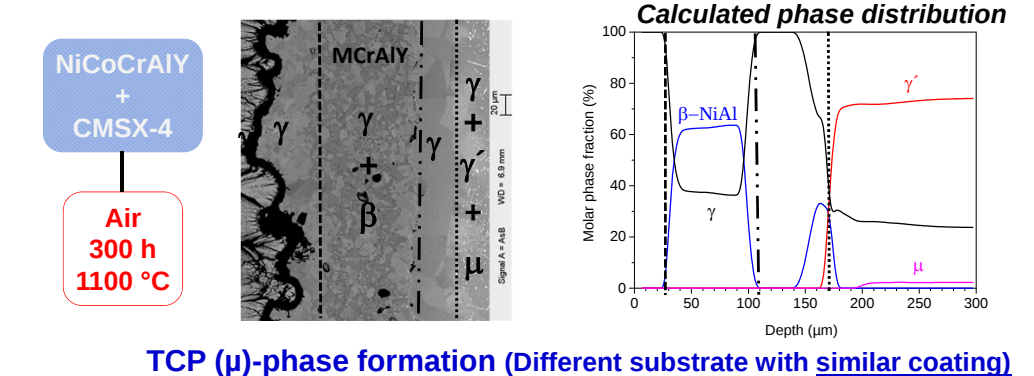
Post-processing

- o Concentration profiles
- o Phase fractions
- o Zone widths (IDZ, SRZ)

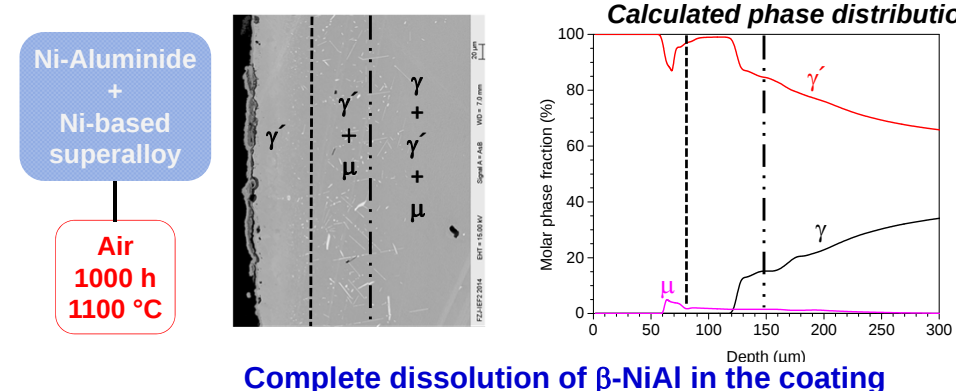
Microstructural evolution in an MCrAlY-coating system



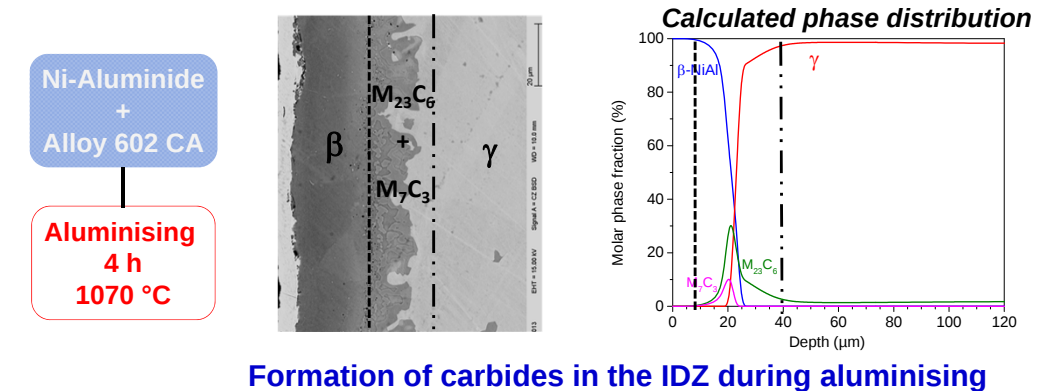
Microstructural evolution in an MCrAlY-coating system



Depletion of β -NiAl in a Ni-Aluminide coating



Modelling of aluminising process



Conclusions

- A coupled thermodynamic & kinetic model was developed to describe the microstructural evolution in corrosion resistant coatings.
- A flux-based computation (Homogenisation Model) of diffusion/precipitation processes allows modelling of complex boundary conditions.
- The in-house developed software code allows implementation of external thermodynamic and kinetic data.

Acknowledgements

Colleagues at FZ-Jülich are acknowledged for performing oxidation tests (H. Cosler and A. Kick) as well as SEM-studies (Dr. E. Wessel and Dr. D. Grüner)