Electrophoretic Deposition for cost-reduced Solid Oxide Cell Interconnects

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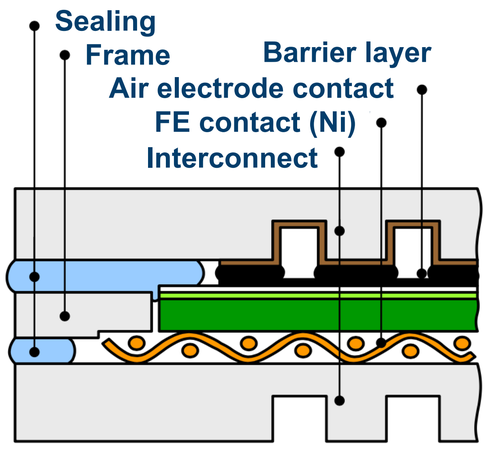
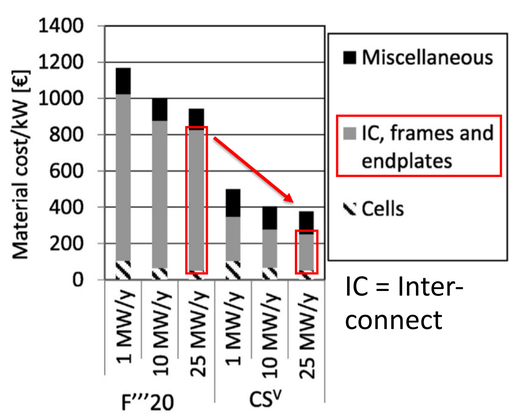
Introduction + Motivation



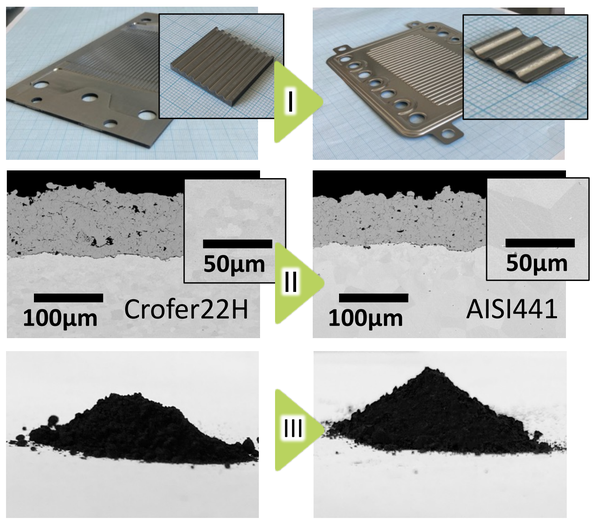
FE = Fuel Electrode



IC = Inter-connect

Harboe *et al.*, *Int. J. Hydrogen Energy*, 2020

Strategies for Cost-Reduction



Thinner Interconnects
Reduce material/process costs
Coating method to be adaptable

Conventional Stainless Steels
Commercial availability
Established recycling routes

Alternative Coating Materials
Less/no Cobalt consumed
Social and ecological benefits

Materials and Processes

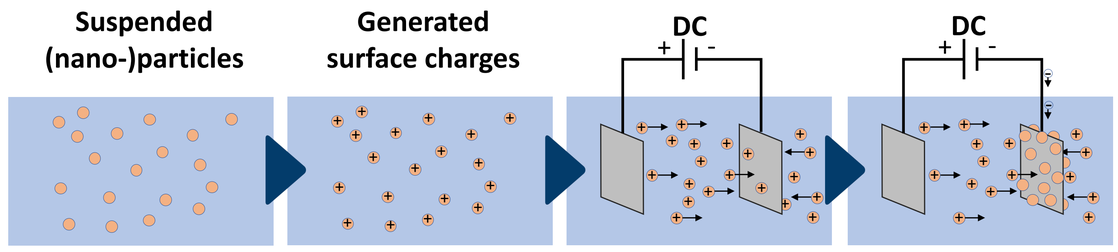
State-of-the art (FZ Jülich)

Interconnect
Ferritic stainless steels
→ Crofer22APU, Crofer22H
Coating
Mn-Co-based Spinels
$(Mn,Co,(Fe))_3O_4$
Coating method
Atmospheric Plasma Spraying

Alternatives

Interconnect
Commercial stainless steels
→ AISI430, AISI441
Coating
Co-free Spinels
→ $(Cu,Mn,(Fe,Ni))_3O_4$
Coating method
Electrophoretic Deposition

Electrophoretic Deposition (EPD)



Hamaker's equation:
$m = C_s \mu S E_t$

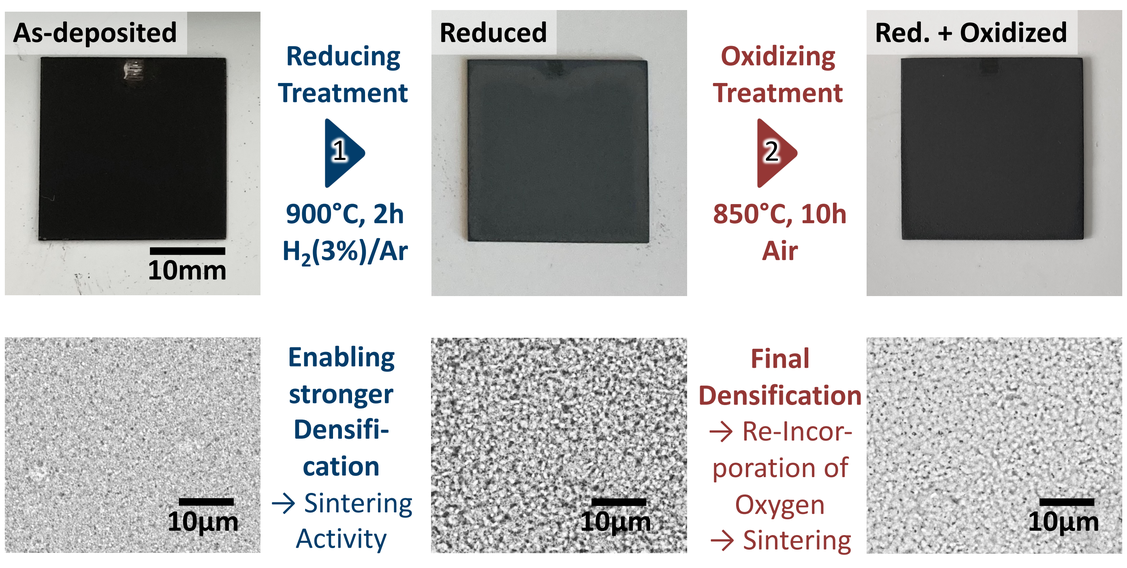
$\mu = \frac{\varepsilon \xi}{4\pi\eta} = \frac{\nu}{E}$

m = deposited mass
C_s = solid load in suspension
μ = electrophoretic mobility
S = deposited surface
E = applied electric field
t = deposition time

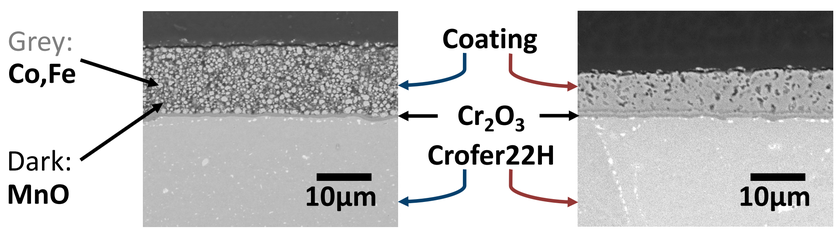
ε = liquid's dielectric constant
ξ = Zeta potential of particles
η = liquid's viscosity
ν = particle velocity

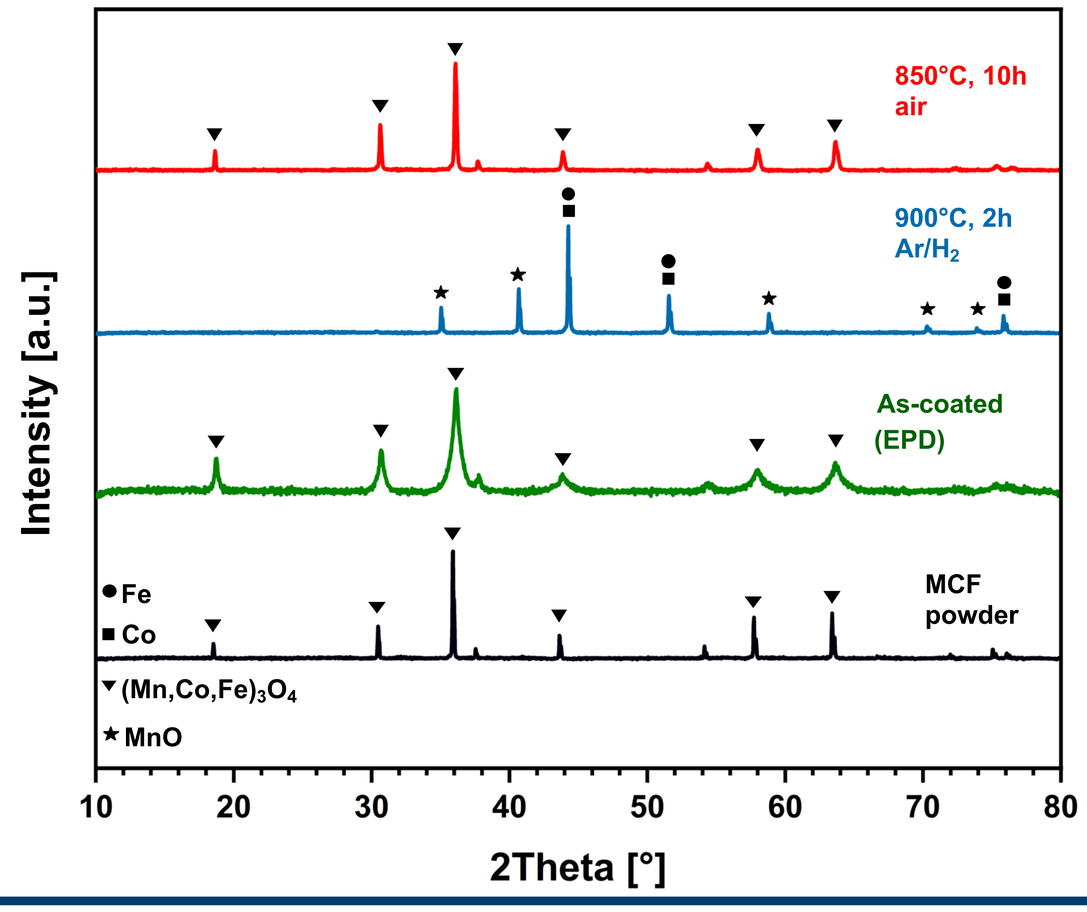
Deposition of coatings in the range of a **few µm** thickness on **complex geometries**
→ curved or grooved ICs

Thermal Processing of EPD-coatings



As-deposited coatings are brittle and tend to stick to epoxy and peel off during epoxy hardening





Conclusion

Large potential of **reducing SOC** processing and material **costs** lays in **interconnect**

EPD-Spinel-coatings display a meaningful strategy for **commercial interconnects**

Outlook

Optimization of EPD-coatings with **alternative materials** on **real structures**

Characterization of coatings properties at **lab-scale** and on **stack-level**

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