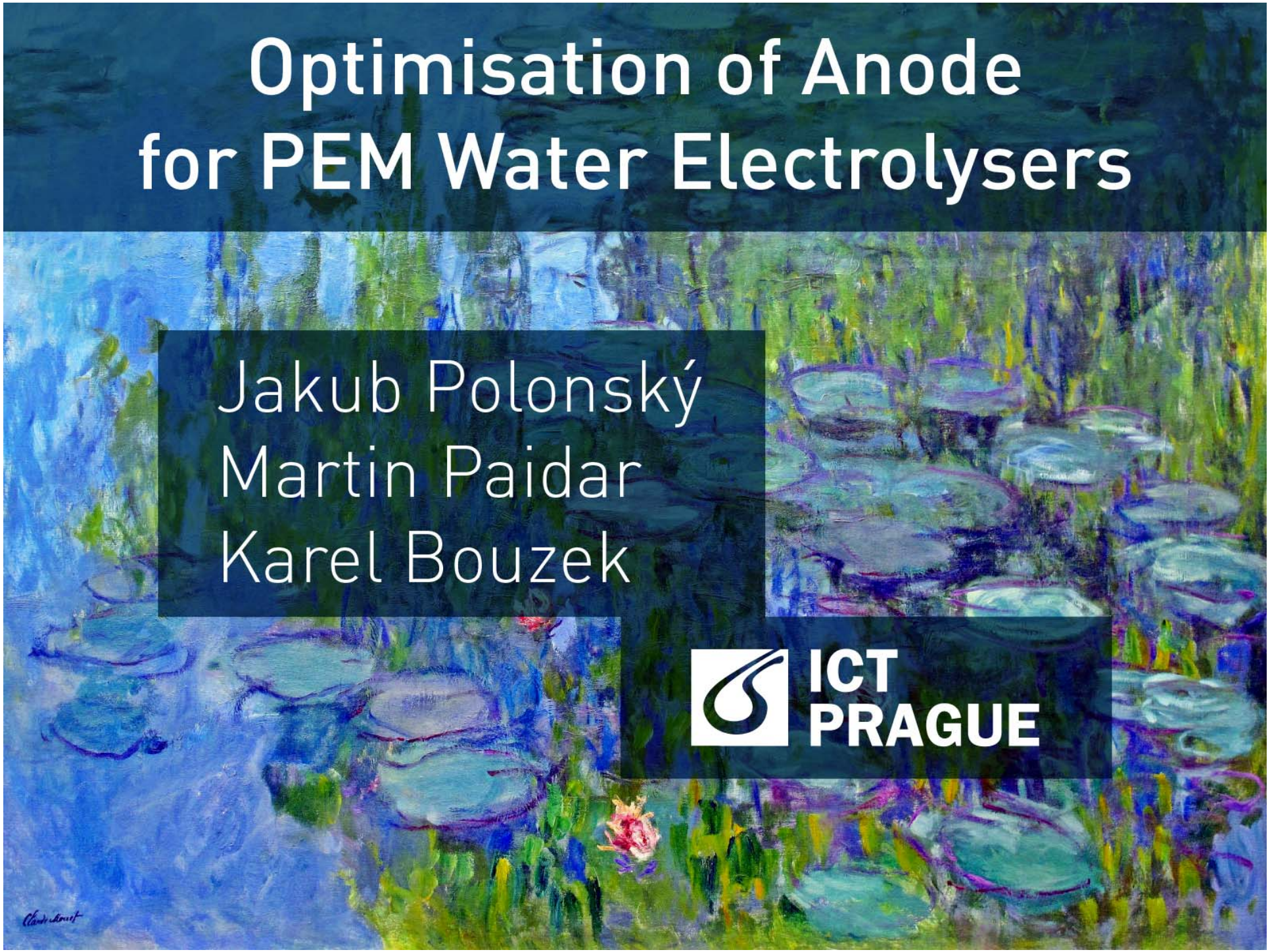
Optimisation of Anode for PEM Water Electrolysers



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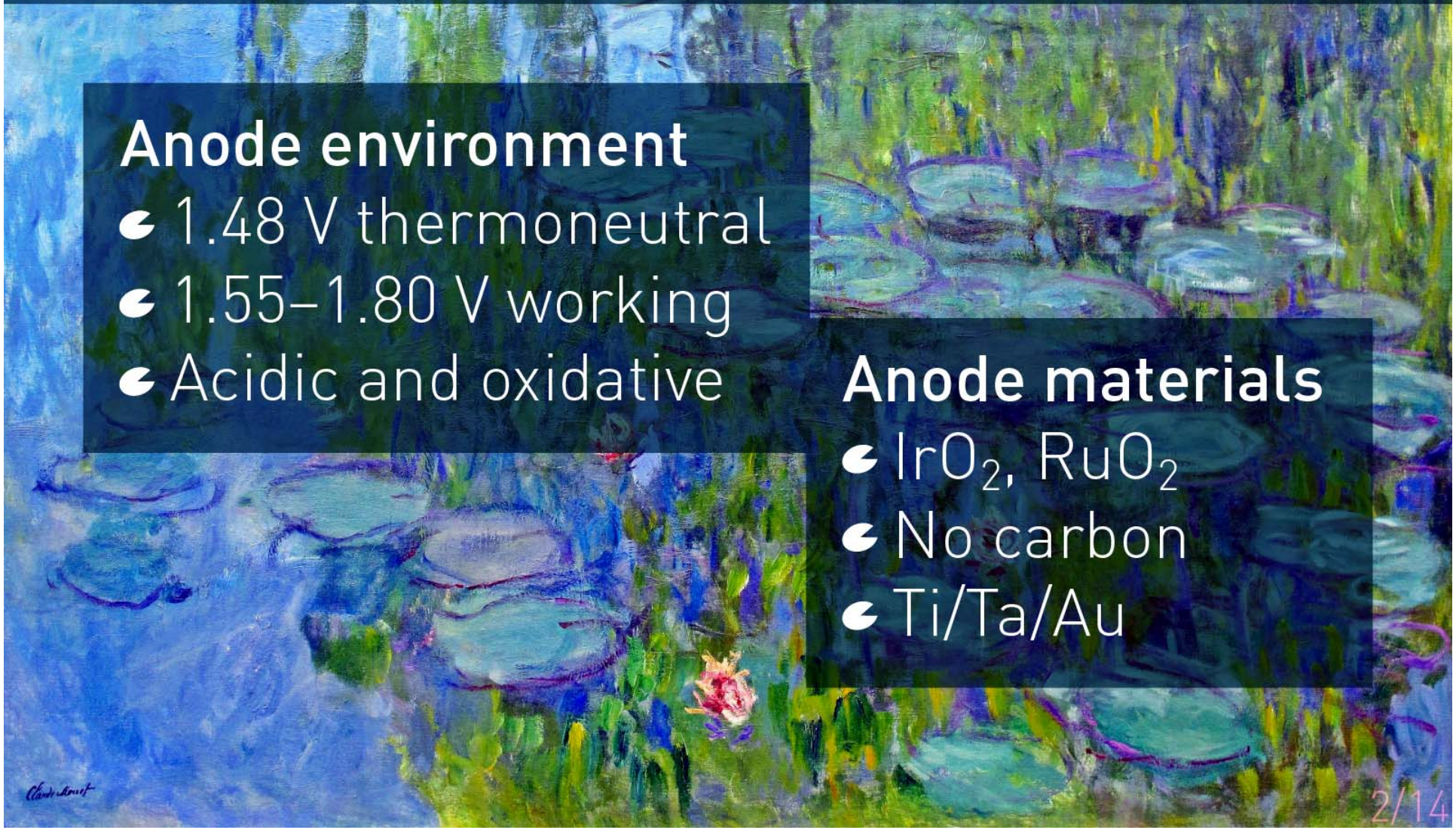
Martin Paidar
Karel Bouzek

ICT PRAGUE

Like a Reversed Fuel Cell*

*differences may apply



Anode environment

- 1.48 V thermoneutral
- 1.55–1.80 V working
- Acidic and oxidative

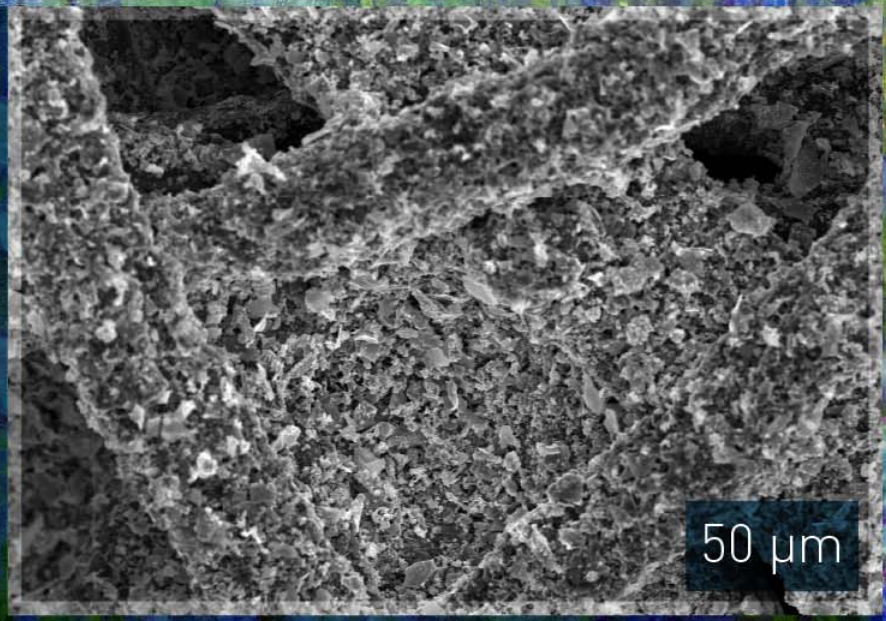
Anode materials

- IrO_2, RuO_2
- No carbon
- Ti/Ta/Au

Why and How to Optimize the Anode

Why

- Use less Ir
- Lower cell voltage
- Increase service life



How

- Supported catalyst
- Microporous layer
- Material choice and geometry

Supported Catalyst

How does it work

- Better dispersion
- Reduced penetration into electrode
- Synergistic effects

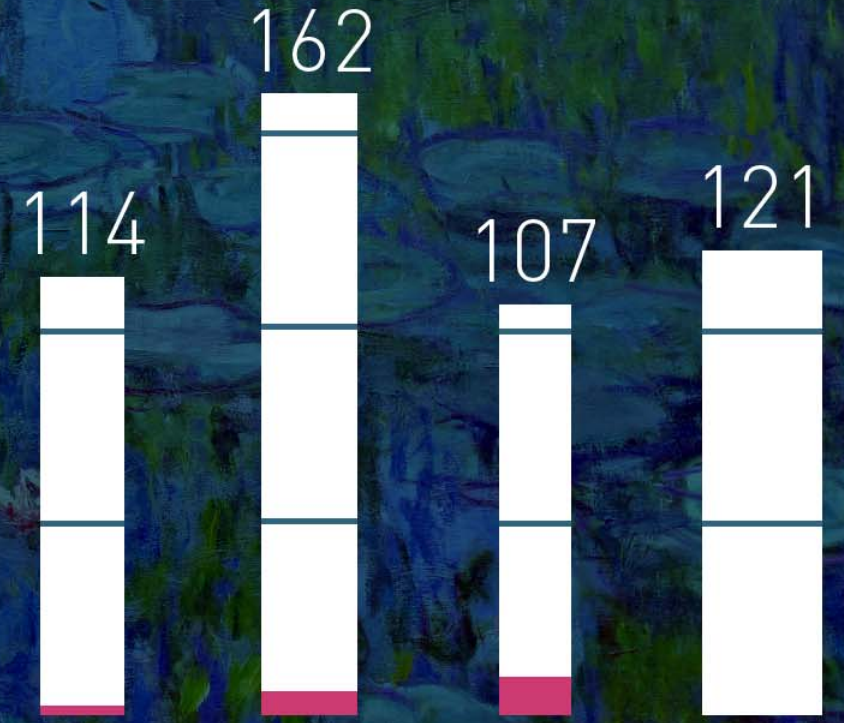
Material candidates

- Conductive: **TaC**, **ß-SiC**, TiO_x, ATO
- Non-conductive: **TiO_2**, Si_3N_4

Supported Catalyst

Specific Surface Area (BET)

Recalculated to IrO_2 part [m^2/g]



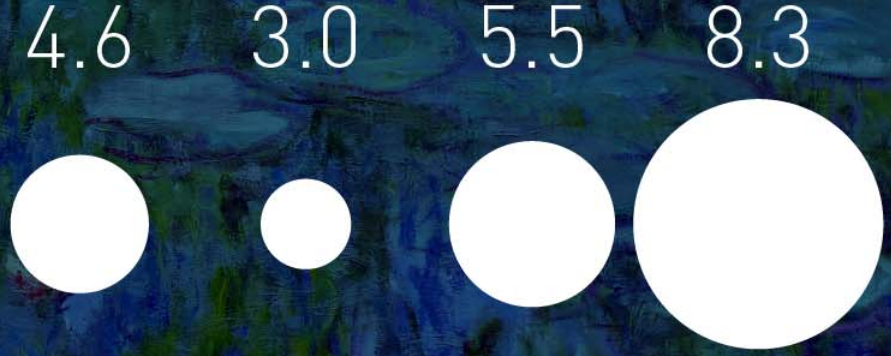
	TaC	ß-SiC	TiO_2*	IrO_2
IrO_2 wt. %	70	80	60	100

* Precheza Pretiox R-200M

Supported Catalyst

Crystallite Size (XRD)

Of the IrO_2 [nm]

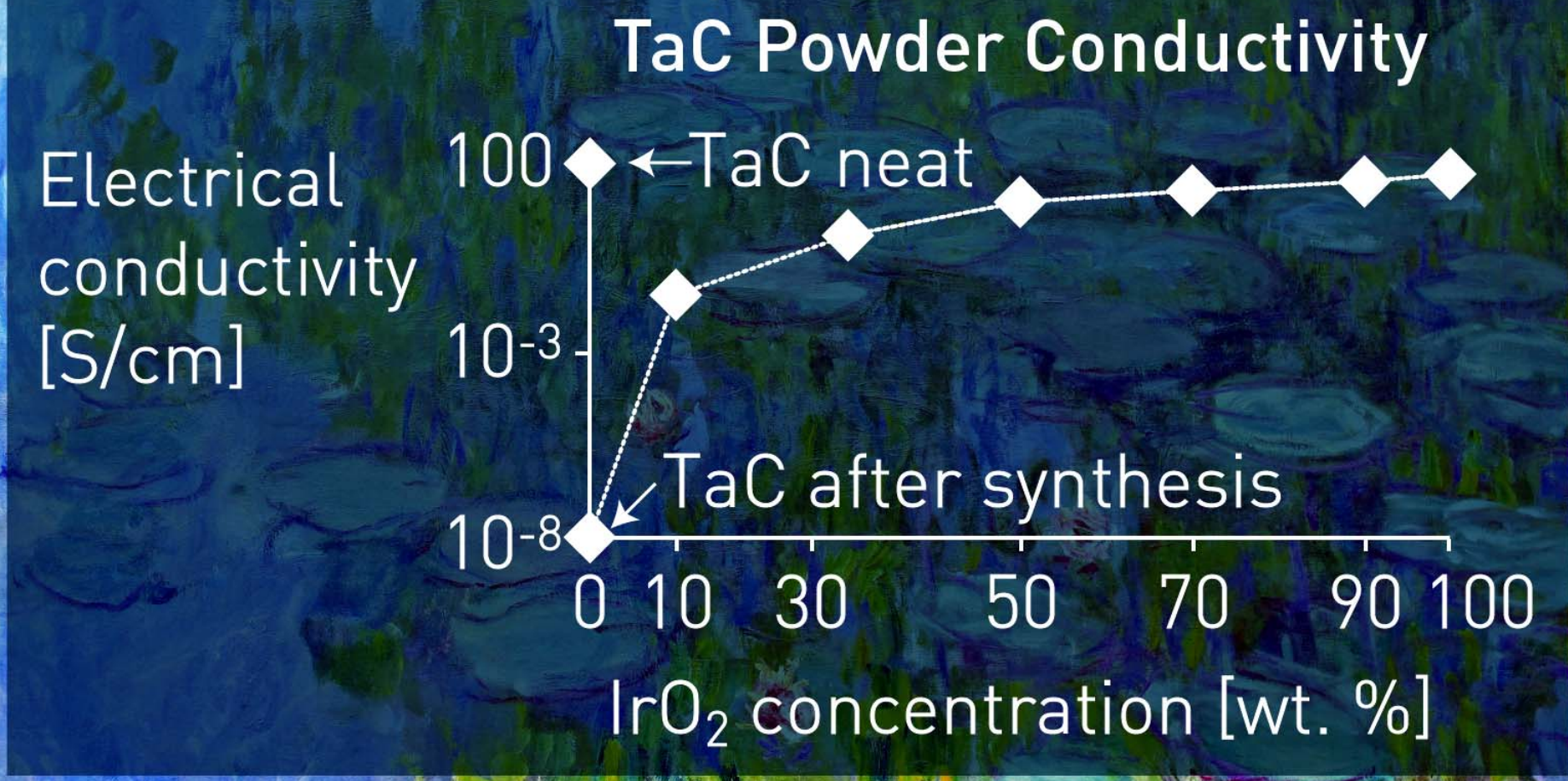


‘ Precheza
Pretiox
R-200M

	TaC	ß-SiC	TiO_2‘	IrO_2
IrO_2 wt. %	70	80	60	100

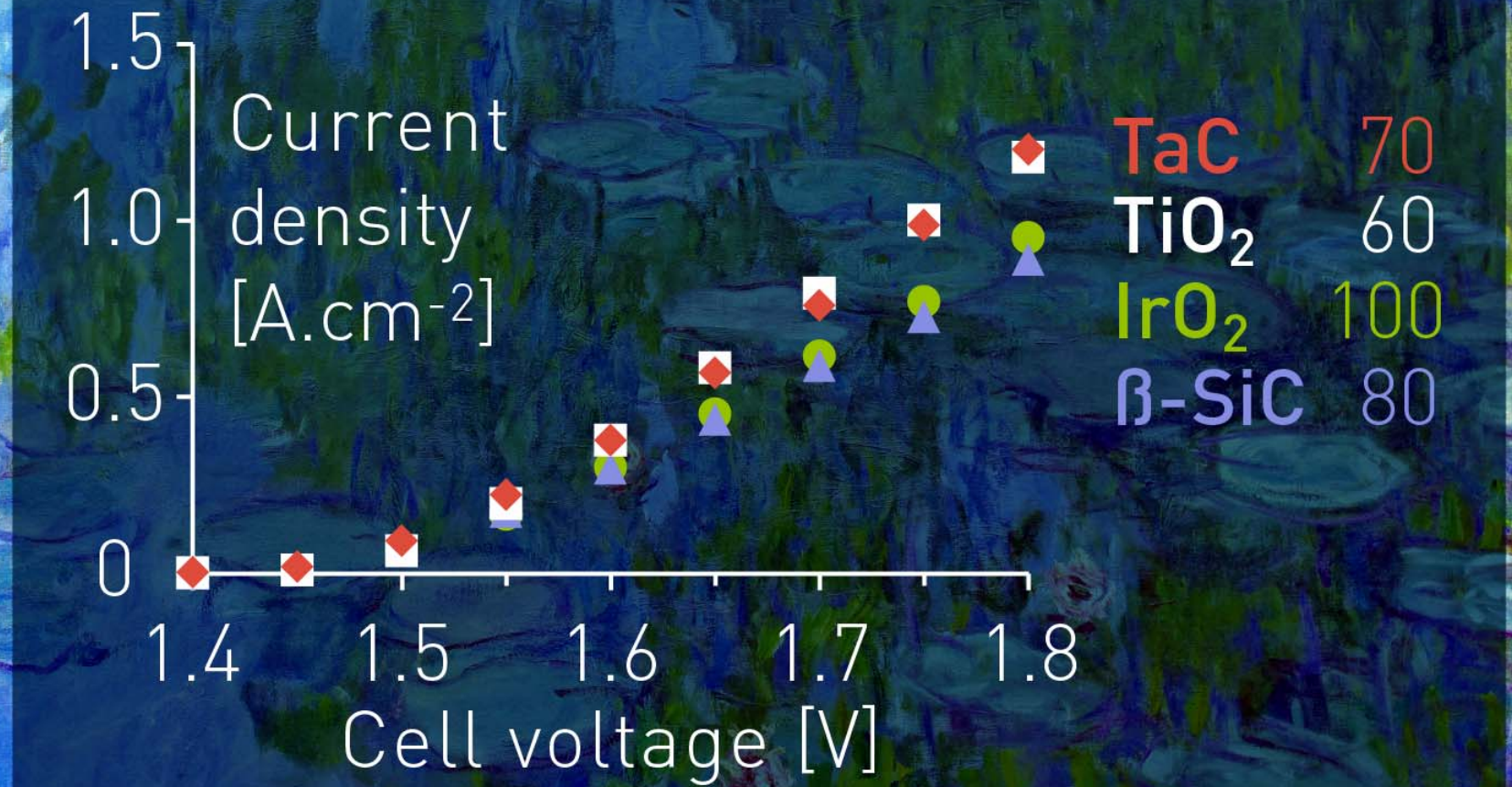
Supported Catalyst

Powder Conductivity



Supported Catalyst

PEMWE Load Curves



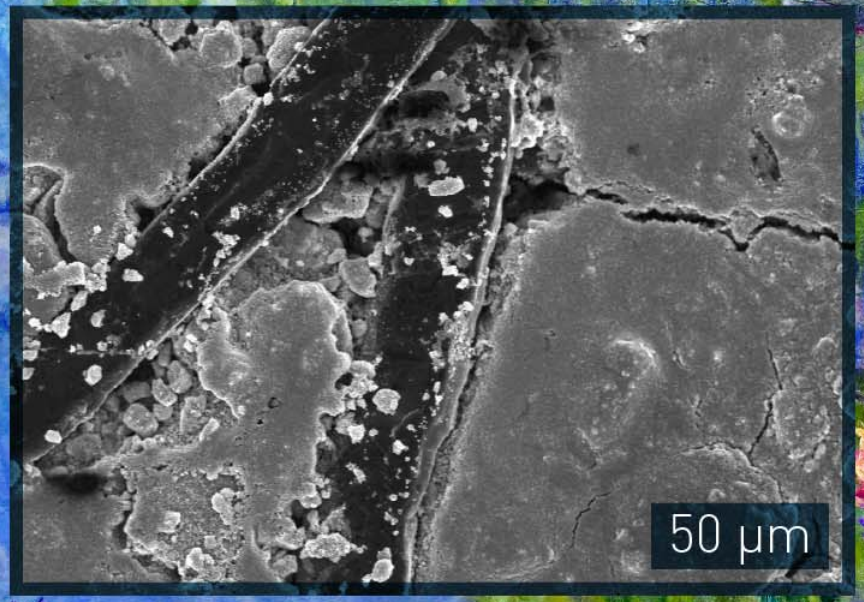
Anode recalculated to 1.0 mg Ir/cm²; Cathode E-Tek Elat 0.5 mg Pt/cm²; Membrane Nafion 117; 90 °C

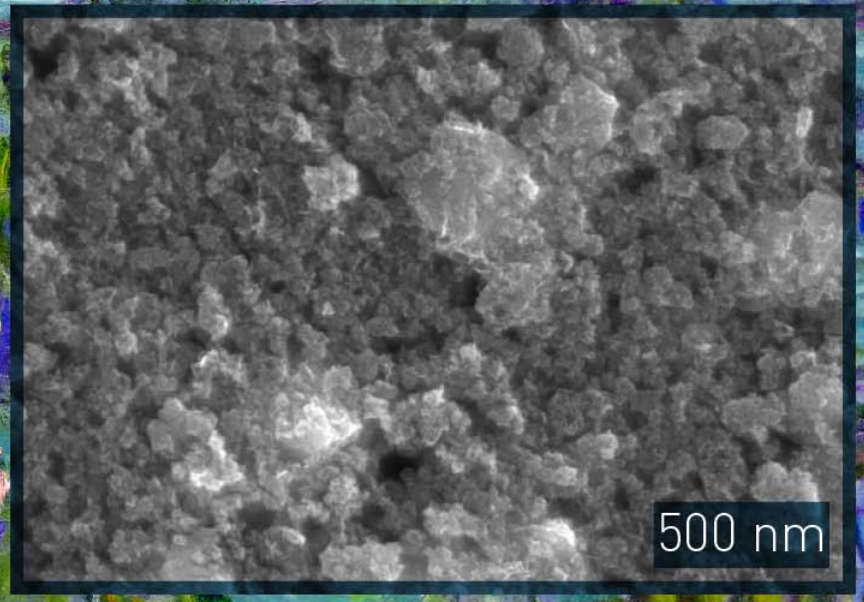
Microporous Layer

SEM Images

Gas diffusion layer

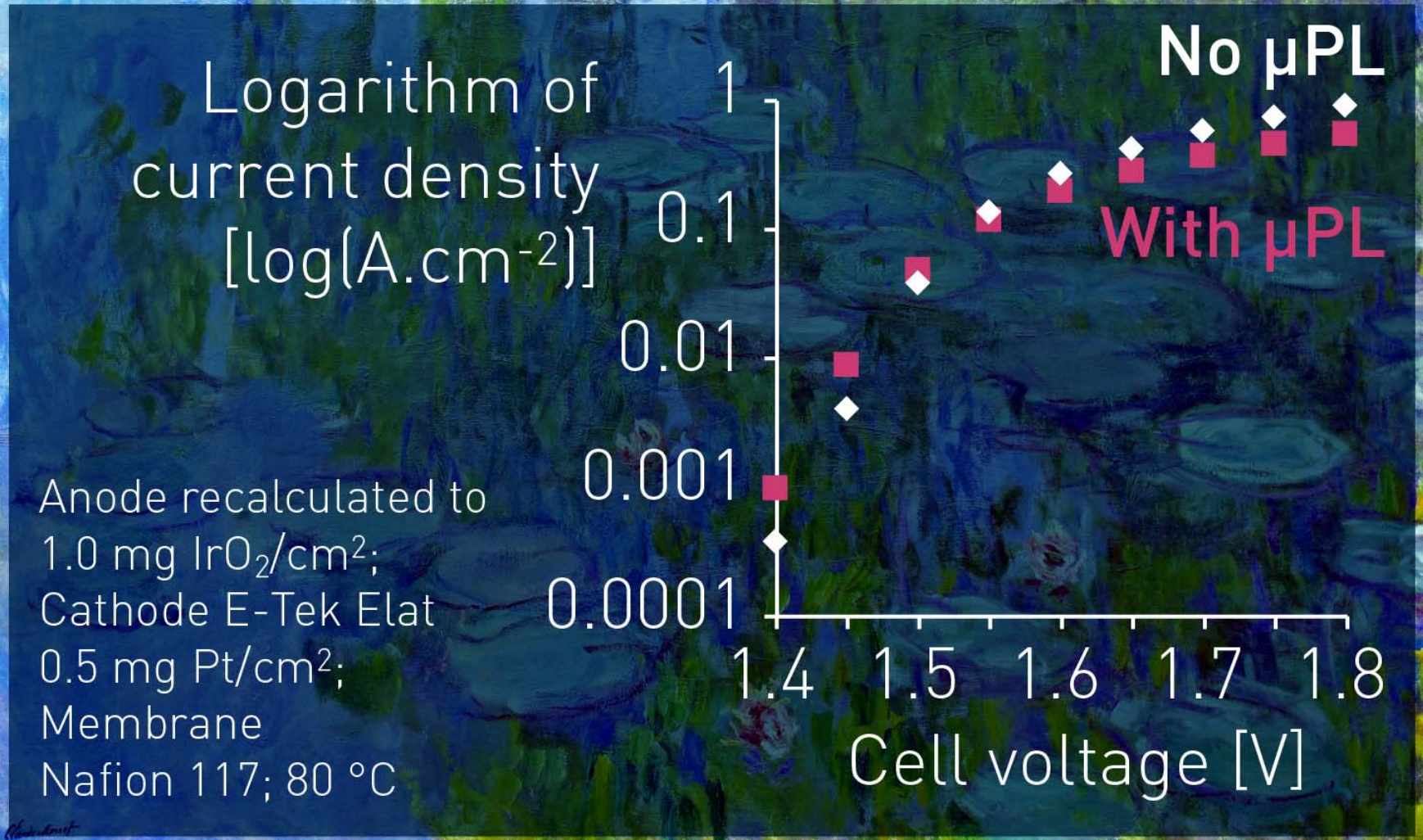
- Ti felt backing
- Antimony tin oxide + PTFE (10 wt. %)





Microporous Layer

PEMWE Load Curves



Anode recalculated to 1.0 mg IrO_2/cm^2;
Cathode E-Tek Elat 0.5 mg Pt/cm^2;
Membrane Nafion 117; 80 °C

Electrode Material Optimization

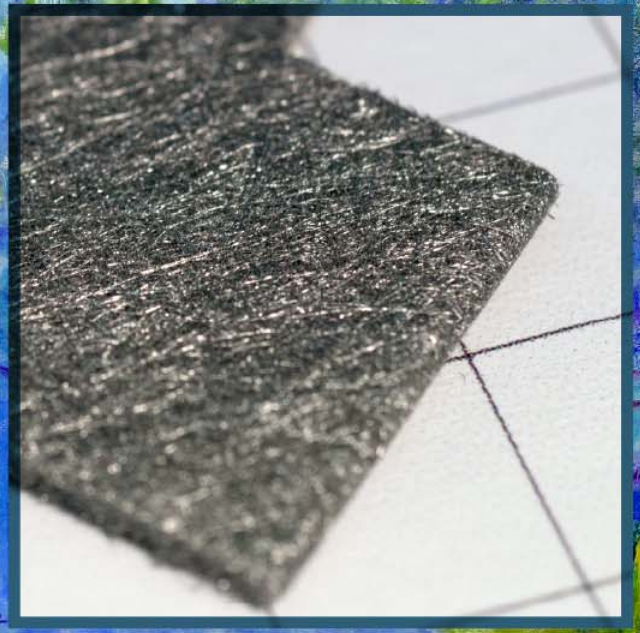
Photographs of Electrode Backing

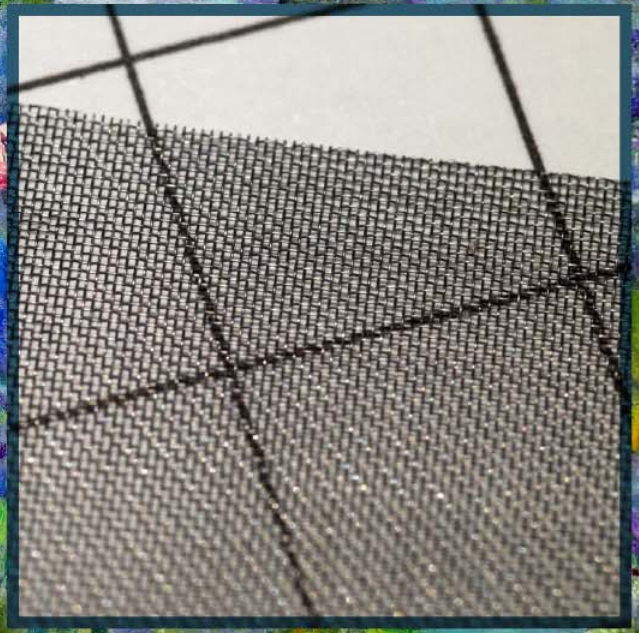
Ti felt

- 1 mm thick
- wires ~20 μm

Ti cloth

- 0.2 mm thick
- wires ~75 μm

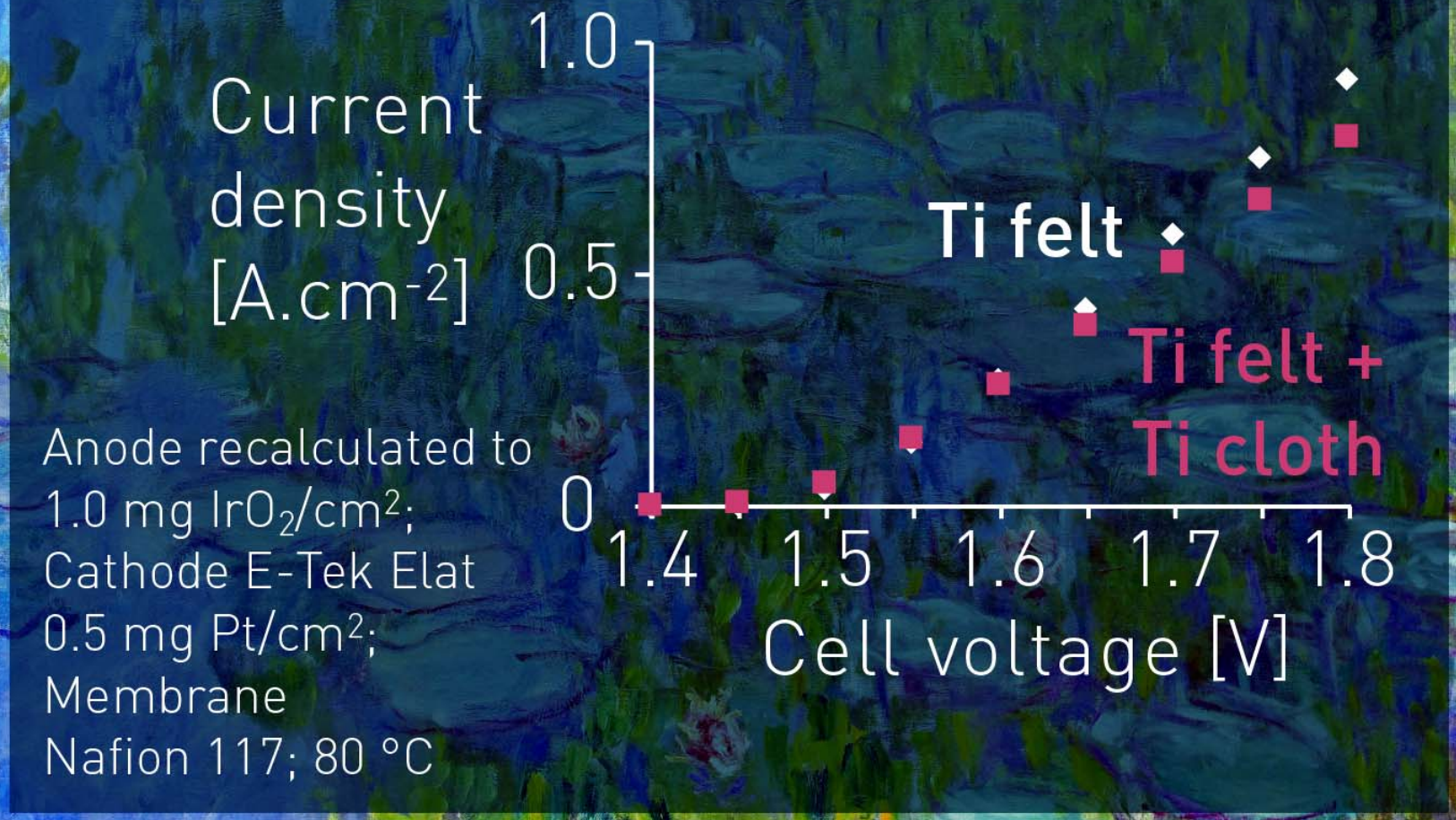




squares under 1×1 cm

Electrode Material Optimization

PEMWE Load Curves



Anode recalculated to 1.0 mg IrO_2/cm^2;
Cathode E-Tek Elat 0.5 mg Pt/cm^2;
Membrane Nafion 117; 80 °C

Putting It All Together

What seems not to work

- Ti cloth
- Microporous layer at higher voltages

What seems to work

- Plain Ti felt
- Supported catalysts (some)


Thank You For
Your attention
Not smoking
Staying awake
Not playing with your smartphone
Keeping a smile
Jakub Polonsky
14/14