Current Distribution on Flooding-resistant Electrodes for CO_2 Electrolysis

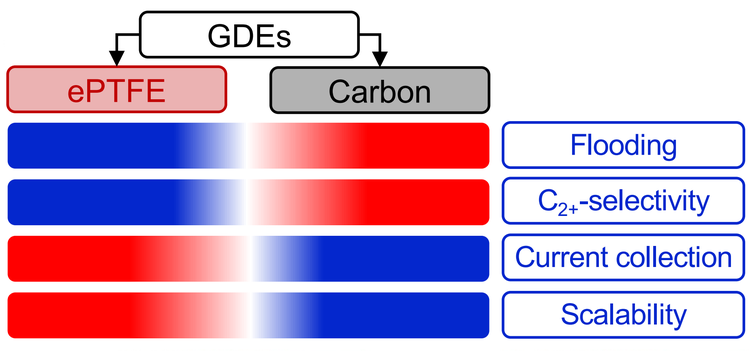
Hugo-Pieter Iglesias van Montfort[1], Thomas Burdyny[1]

[1]Chemical Engineering Department, Faculty of Applied Sciences, **Delft University of Technology**

1. Getting the current where it needs to be

- The complex nature of the reaction environment during CO2-eletrolysis has lead to the development of different gas-diffusion electrode (GDE) architectures
- The vast majority of studies present one of two solutions:
  I. Carbon GDLs: a coarse graphitic backbone with a micro-porous layer (MPL), **electrically conductive**
  II. Expanded PTFE (ePTFE): polymeric, with a much higher hydrophobicity, **electrically non-conductive**

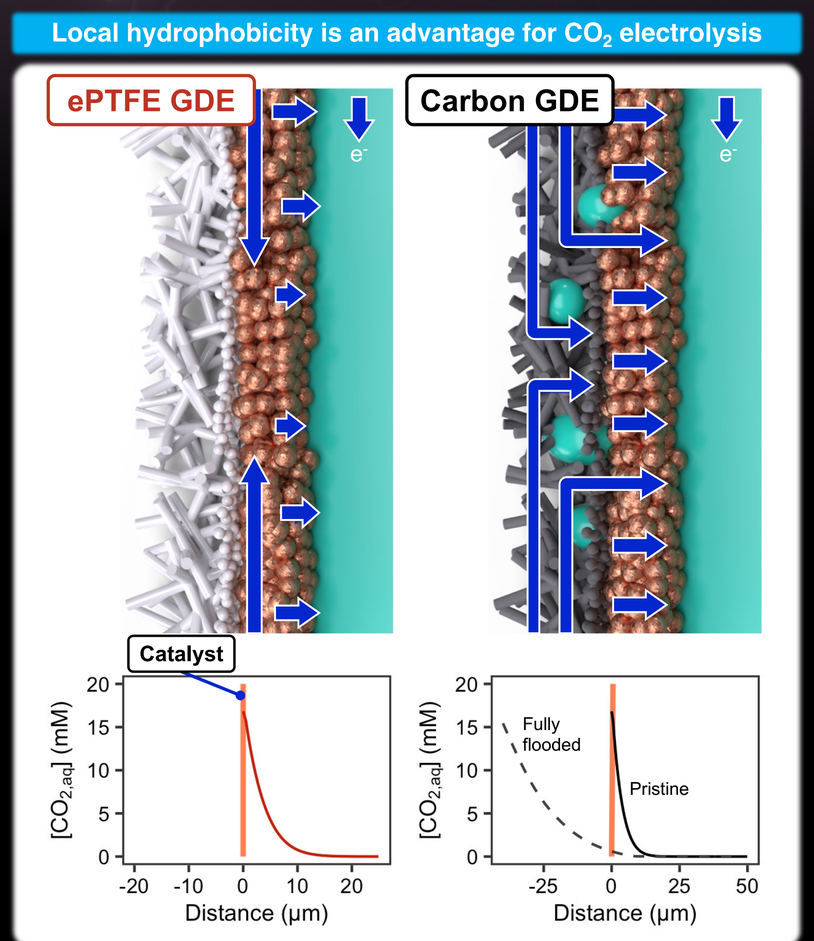
Design considerations for CO_2 electrolysis GDEs



Research Questions:

1. *What are the effects of scale-up on current collection for ePTFE electrodes?*
2. *Can we devise a solution that improves current collection without interfering in product selectivity?*

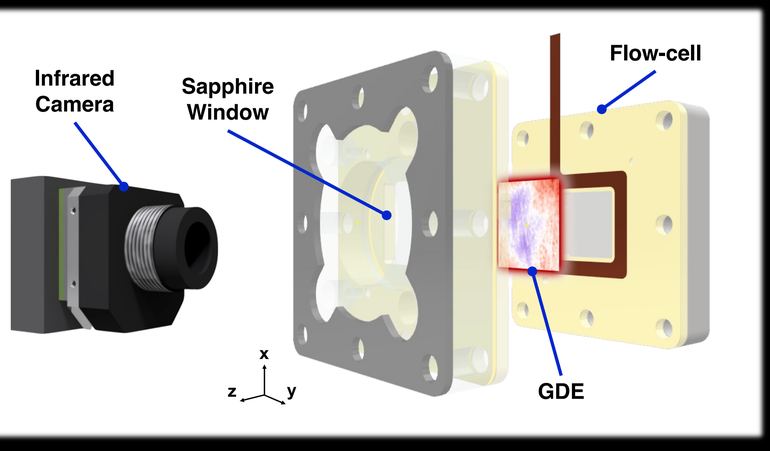
Local hydrophobicity is an advantage for CO_2 electrolysis



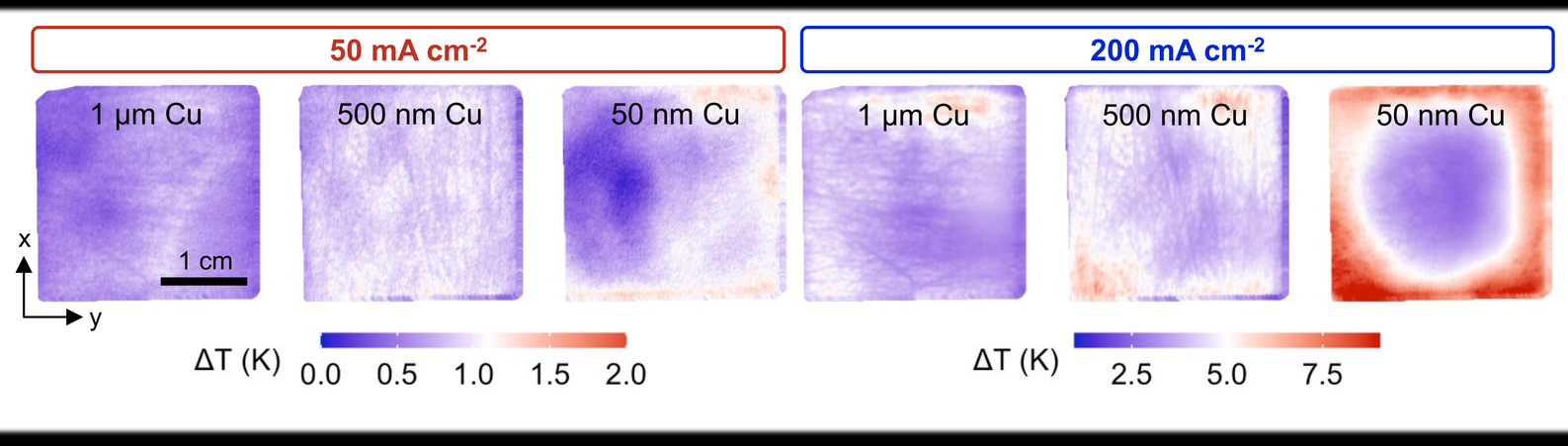
2. Can we sense where our reaction takes place?

- To assess the possiblities of scale-up, current collection must be mapped at increasing *j*'s
- Reducing the catalyst film thickness shows the effect of film conductivity on the distribution of electrochemical activity

State-of-the-art design allows infrared thermography sensing

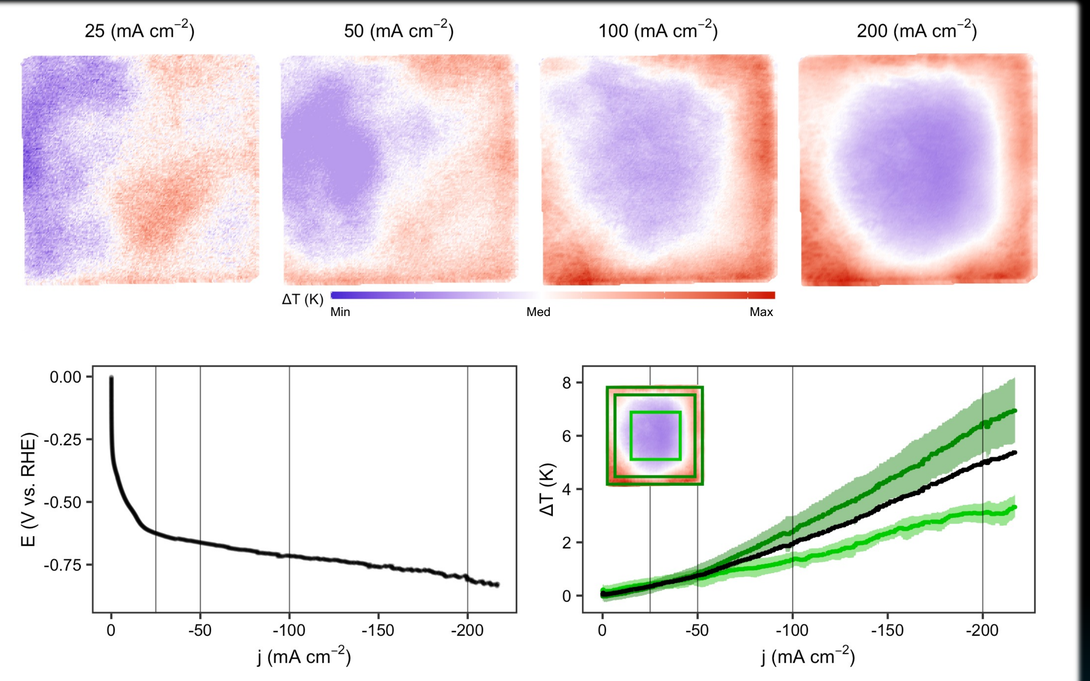


Increasing current densities intuitively show the effect of catalyst-layer thickness on current collection

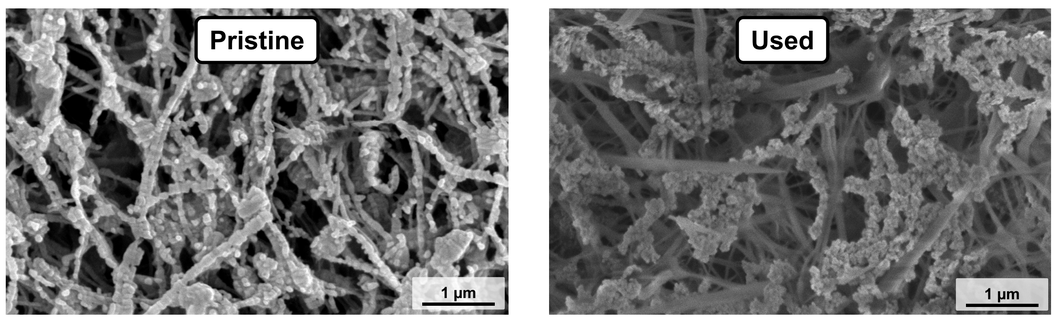


3. Thin-films show problems of poor current distribution

Current density distribution worsens for increasing polarization

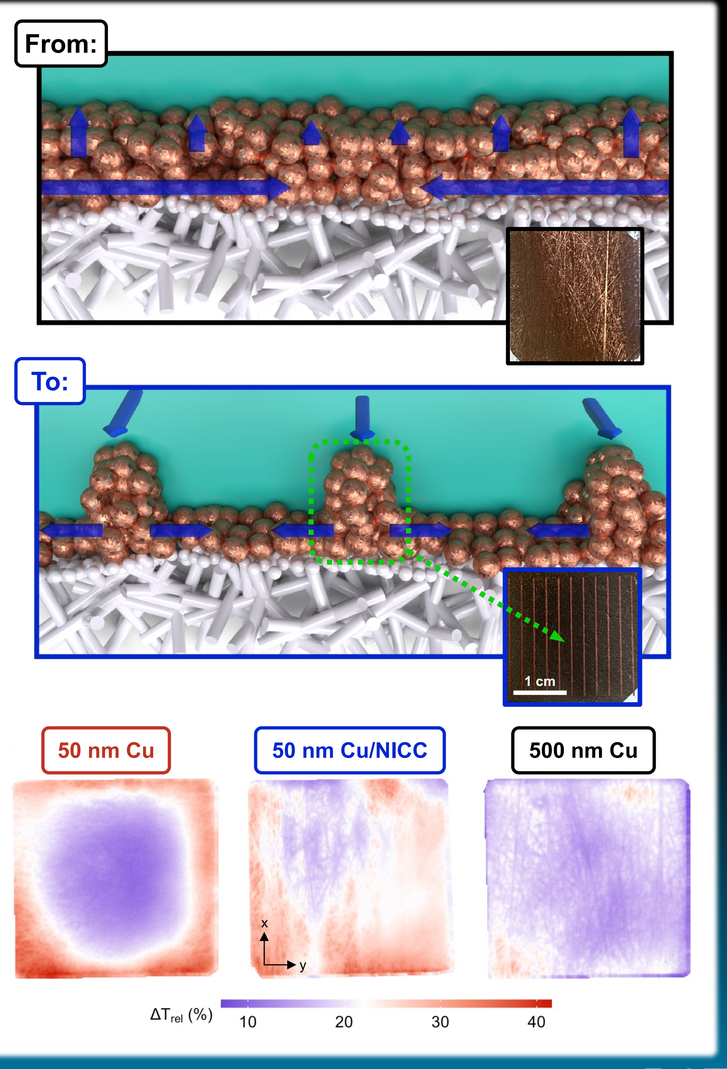


Accelerated catalyst degradation governed by corrosion – increases resistance to current

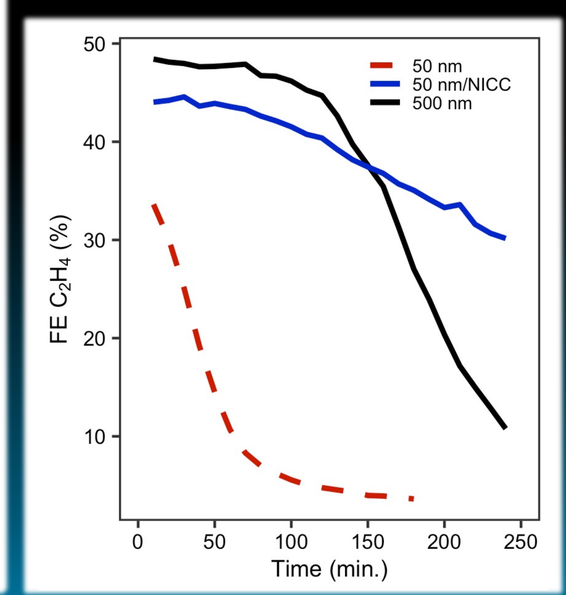


4. A solution: the Non-Invasive Current Collector (NICC)

Copper busbars act as current collection 'highways'



- We show that ePTFE-based electrodes run into current collection issues upon scale-up
- To mitigate this effect, we develop **current-highways**, in the form of **copper busbars**
- The NICC electrode shows **superior activity distribution** and **stability**!



TU Delft Delft University of Technology

e:Refinery

Research Square

FOLLOW US!

CO2 BURDYNY LAB