Optimization of electrochemically deposited Pt and Pt_3Co for PEMFC cathodes

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Motivation

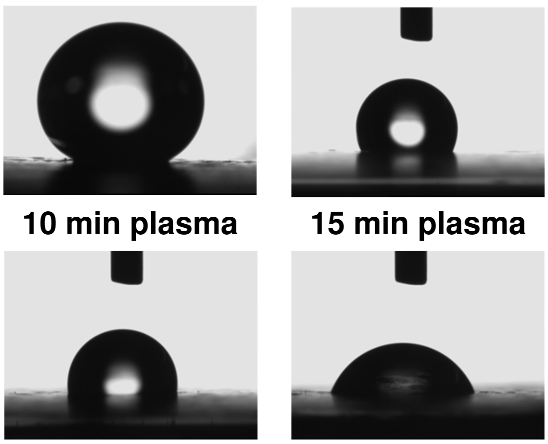
The objective of the project „In-situ electrochemical deposition (ISECD)" is the development of highly-efficient cathodes for PEMFC at an increased noble metal utilization via optimization and qualification of two electrochemical approaches: galvanic (water electrolyte) and potentiostatic (dry Nafion electrolyte, to supress HER during Co) electrodeposition.

Both methods rely on electrochemical reduction of catalyst salt precursors. The catalysts are directly deposited on a microporous layer (MPL) of a gas diffusion susbstrate (GDS) Freudenberg H23C8. The potential advantage of the electrochemical catalyst deposition is the high catalyst utilization towards electrochemical processes as in PEMFC. The teflonized MPL do not allow an optimal electrolyte contact during the electrodeposition. Therefore, an optimized plasma pre-treatment procedure is under development. The electrodeposited cathodes are later on impregnated with an ionomer with an optimized distribution and loading, laminated in MEAs and tested (including durability) in a 25 cm² Baltic Fuel Cell hardware .

Effect of plasma on the MPL surface wettability

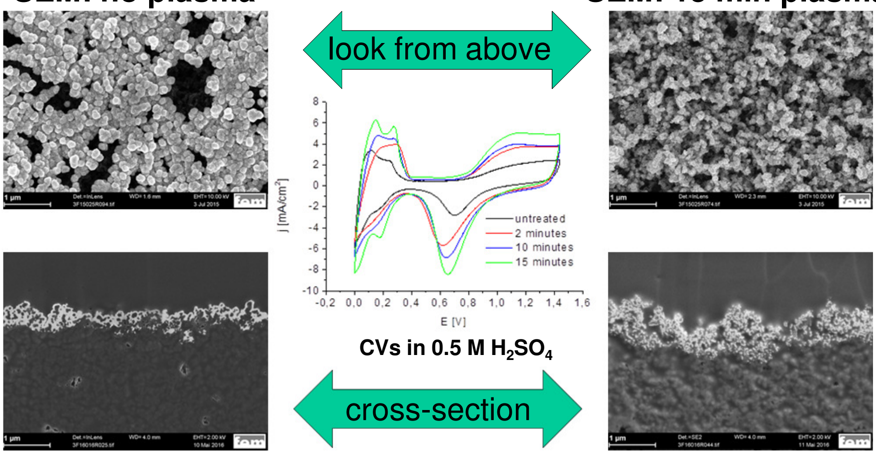
no plasma | **2 min plasma**

10 min plasma | **15 min plasma**



Effect of plasma on the electrodeposited catalyst layer

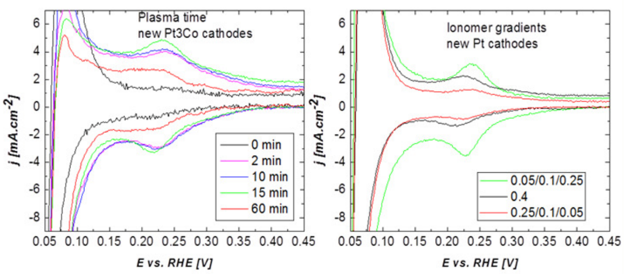
SEM: no plasma | **SEM: 15 min plasma**



CVs in 0.5 M H_2SO_4

PEMFC CVs: effect of plasma and ionomer distribution

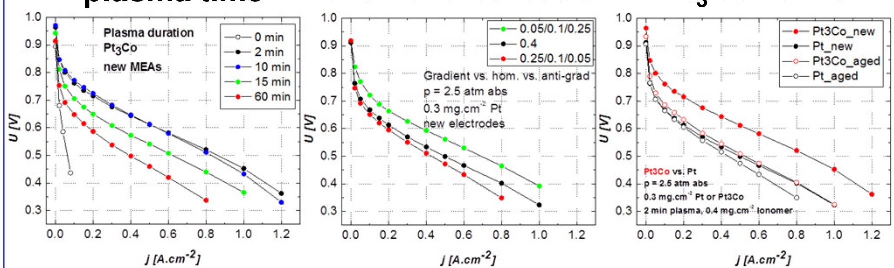
plasma time | **ionomer distribution**



Cyclic voltammetry curves: for ECSA see the Had (lower peaks)

PEMFC polarization curves

plasma time | **ionomer distribution** | **Pt_3Co vs. Pt**



PEMFC polarization curves taken at identical conditions

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