Platinum Group Metal-Free Catalysts for Proton Exchange Membrane Fuel Cells - Electrode Diagnostics for Performance and Durability -Luigi Osmieri^{a,b}



$$P_{tot} = \frac{2FC_{H_2,ch}}{I_2}$$



Understanding Durability during MEA Operation durability in MEA



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Loss of Fe sites $\eta_{\rm C} = E_{\rm rev} - E_{\rm cell} - i \left(R_{\rm HFR} + R_{\rm H^+,eff} \right)$ **Clear correlation between:** ³⁰⁰⁰ AST cycle # > Fe-N, active sites loss - 0.9 **——** 0 **Capacitance increase** Fresh MEA **---**− 1k - 0.8 -**--** 5k (catalyst oxidation) ____10k **Cathode kinetic ––** 20k 🔶 30k - 0.6 overpotential increase -0.5 G -0.4 Ľ - 0.3 **Higher degradation** - 0.2 **30k AST cycles** caused by cathode in air operation in - 0.1

Frm **EIS**: No change in $R_{\rm HFR}$ and $R_{\rm H^+,eff} \rightarrow No \ damage \ to$ membrane and ionomer in CCL

2 nm

ORR generates $H_2O_2 \rightarrow HO^{-1}$ and **HOO'** radicals by Fenton reaction with Fe which damage the catalysts

presence of O₂





