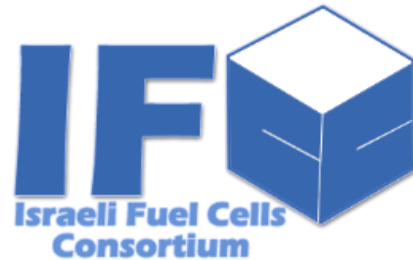

Israel Fuel Cells Consortium (IFCC)

Prof. Lior Elbaz

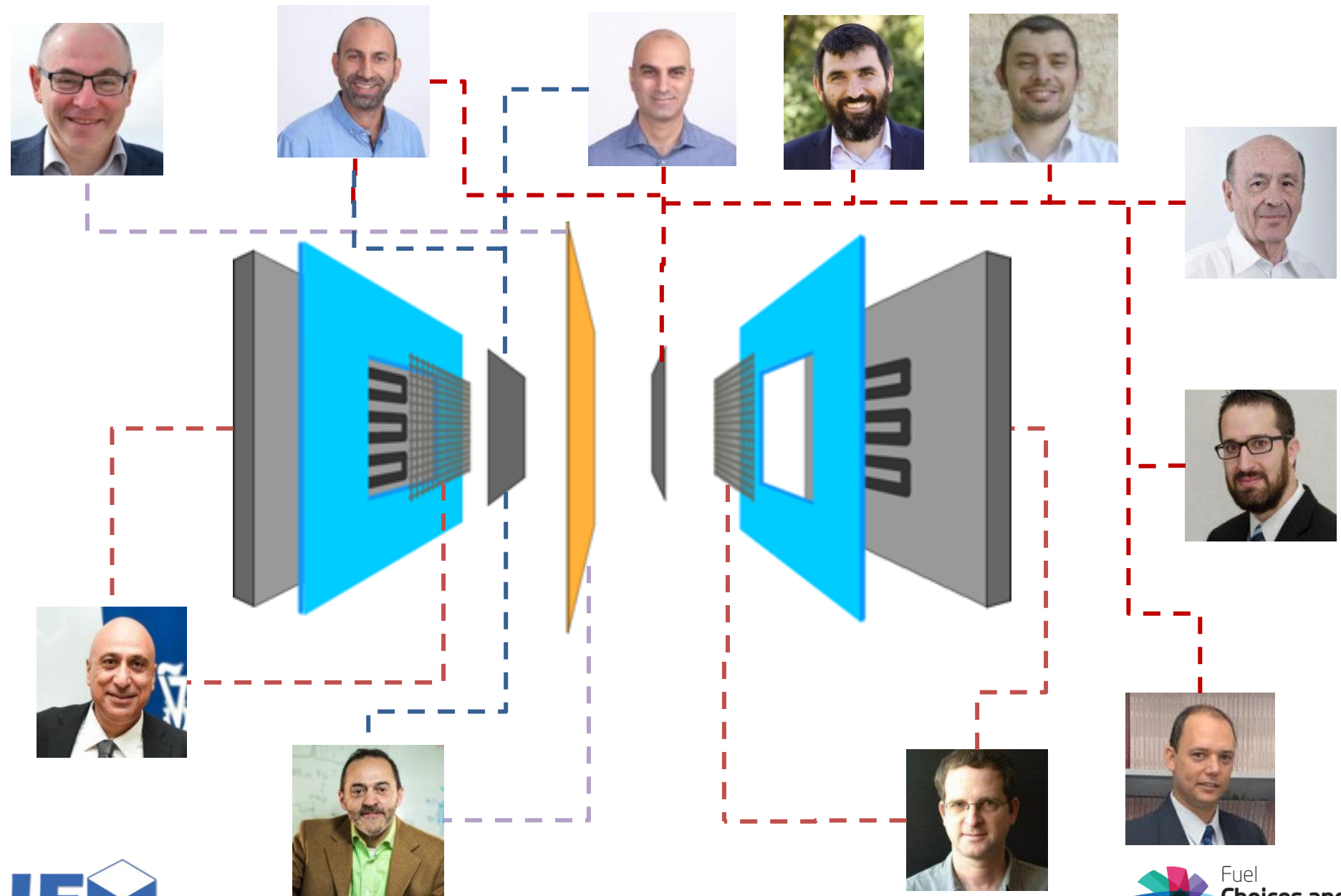
lior.elbaz@biu.ac.il

Bar-Ilan University, Israel

Israel Fuel Cells Consortium (Head)



Israeli Fuel Cells Consortium (IFCC)



Team 1: Electrochemistry (E-Team):

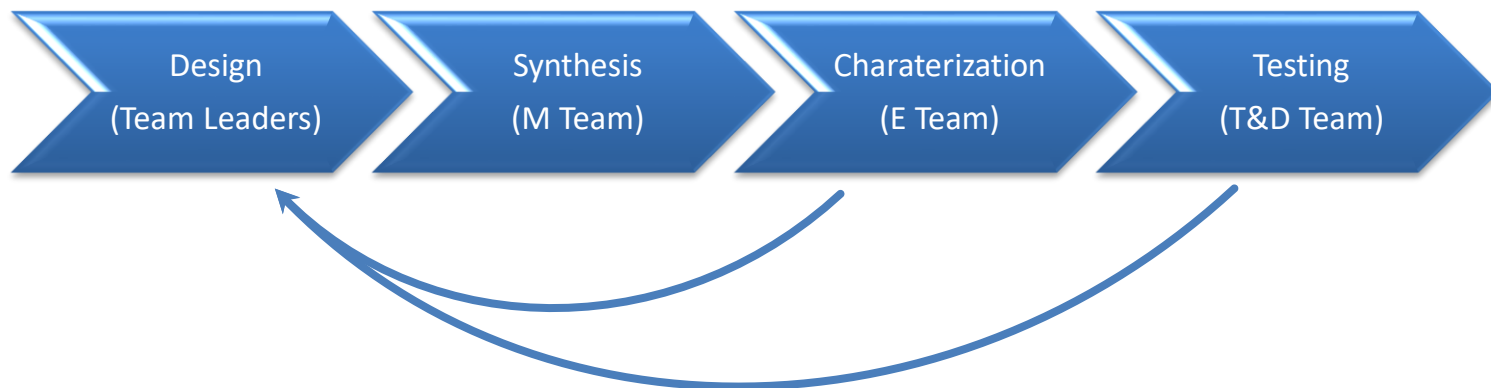
- 1) Dr. Lior Elbaz (Head, Team Leader)
- 2) Prof. Zeev Gross (Electrocatalysis)
- 3) Dr. Brian Rosen (Electrochemical Engineering)
- 4) Prof. Ilya Grinberg (Electrocatalysis – Theory)

Team 2: Materials (M-Team):

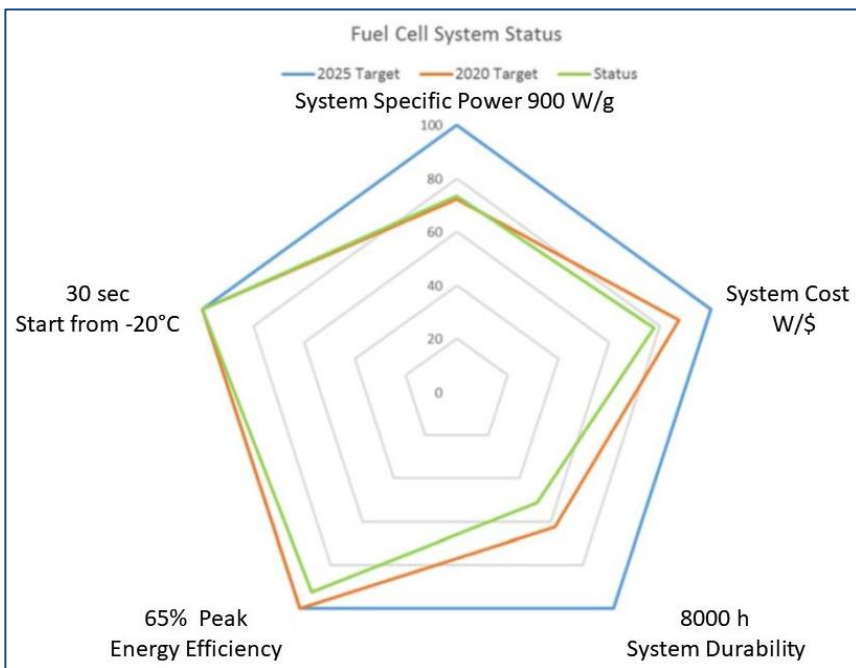
- 1) Prof. Emanuel Peled (Team Leader)
- 2) Dr. Alex Schechter (Materials Science)
- 3) Prof. David Zitoun (Nano-technology)
- 4) Prof. Slava Freger (Membrane Technology)
- 5) Dr. David Eisenberg (Carbon Materials)

Team 3: Testing & Durability (T&D-Team):

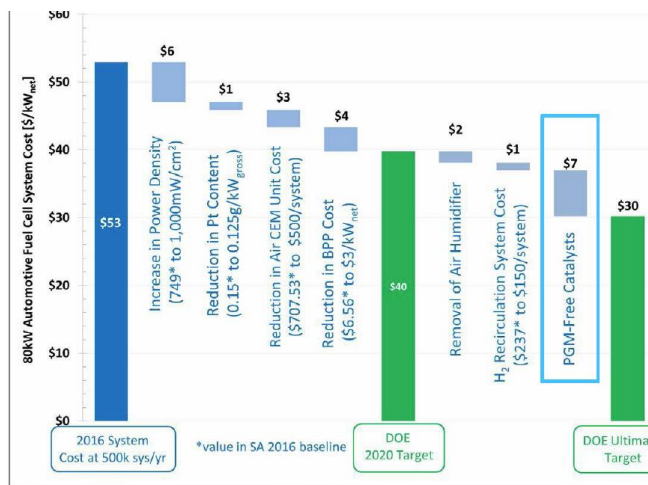
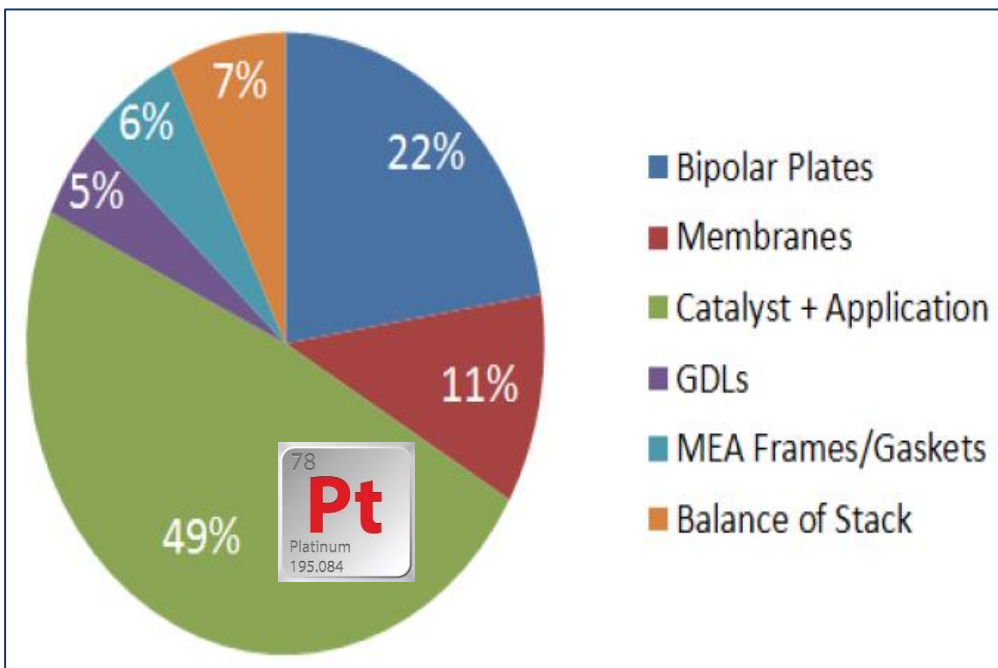
- 1) Prof. Yair Ein-Eli (Team Leader)
- 2) Prof. Yoed Tsur (Electroanalysis)
- 3) Prof. Dario Dekel (FC Technology)



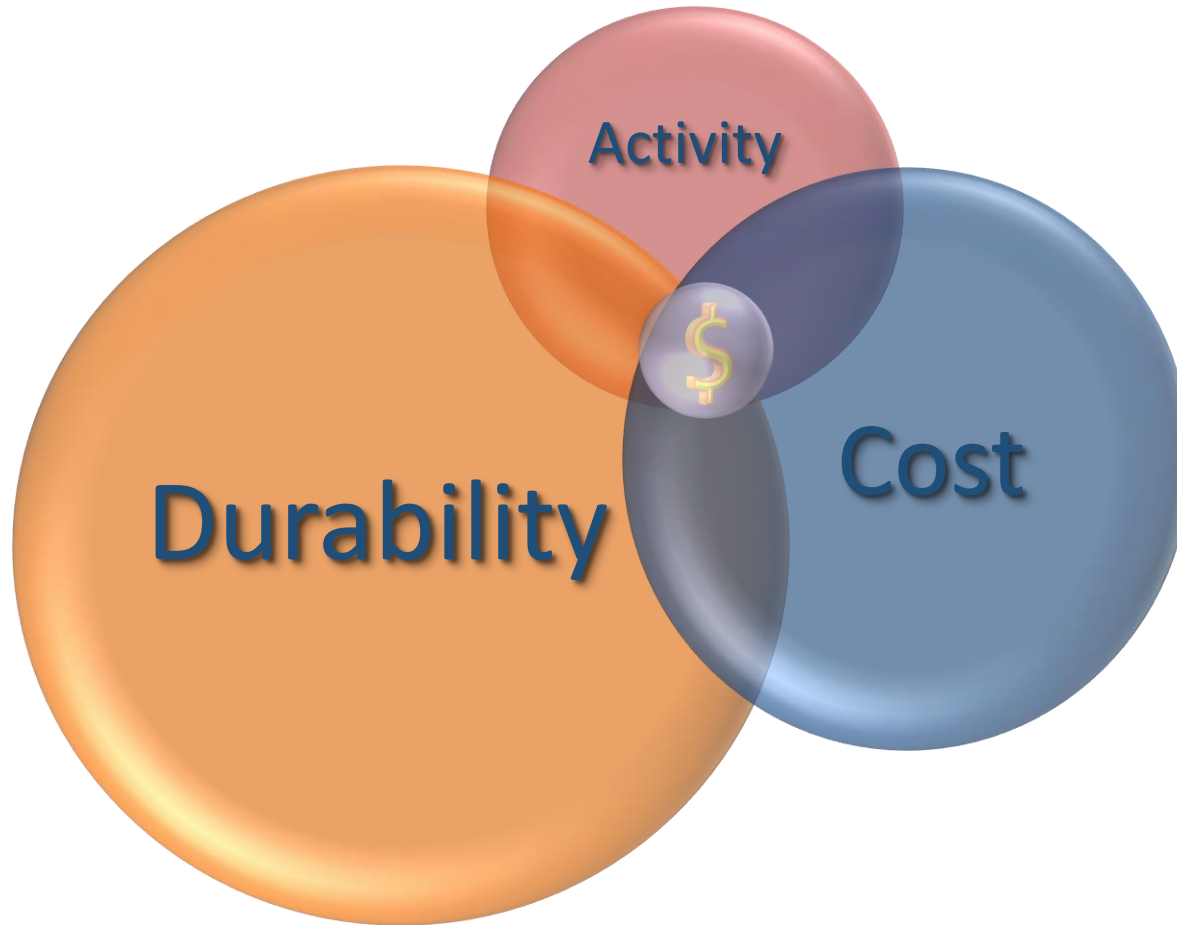
Current Status



Cost Breakdown

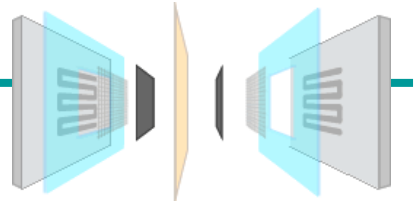


IFCC Main Challenges



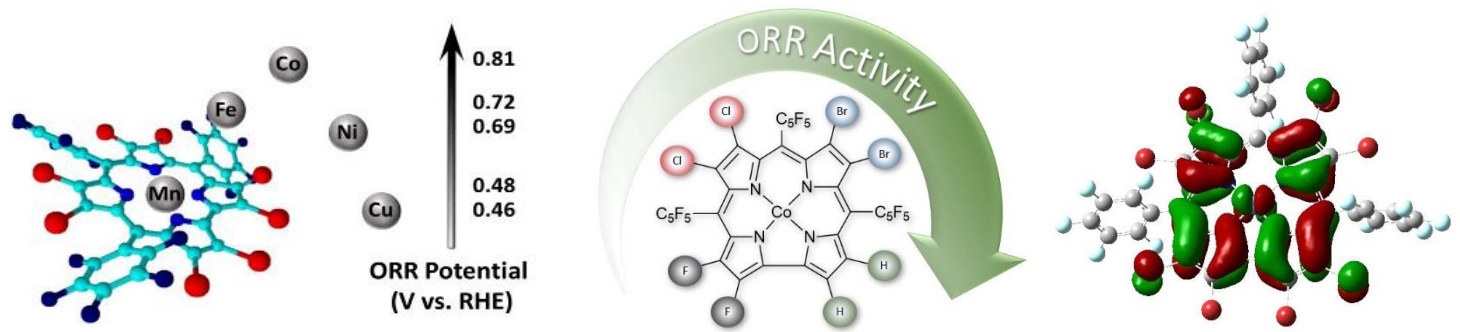
Achievements Highlights

Achievements: **Cost**

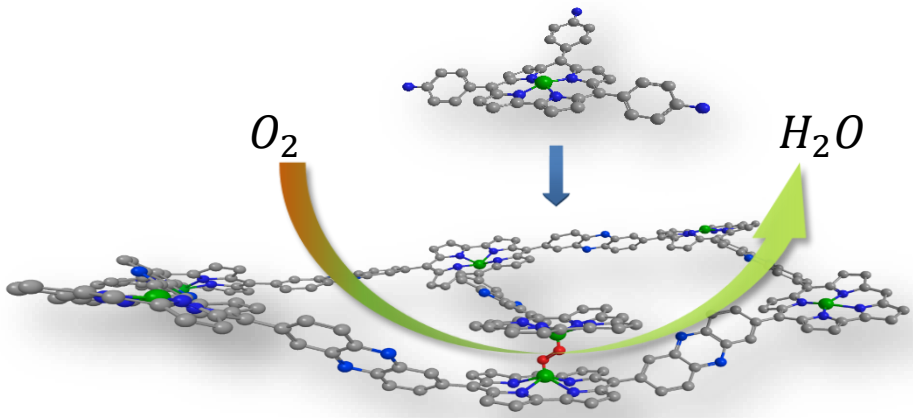


- **Development of non-precious metal Catalysts:**

Synthesis and characterization of transition metal complexes with high and efficient reactivity towards oxygen reduction. Electrochemical and theoretical studies.

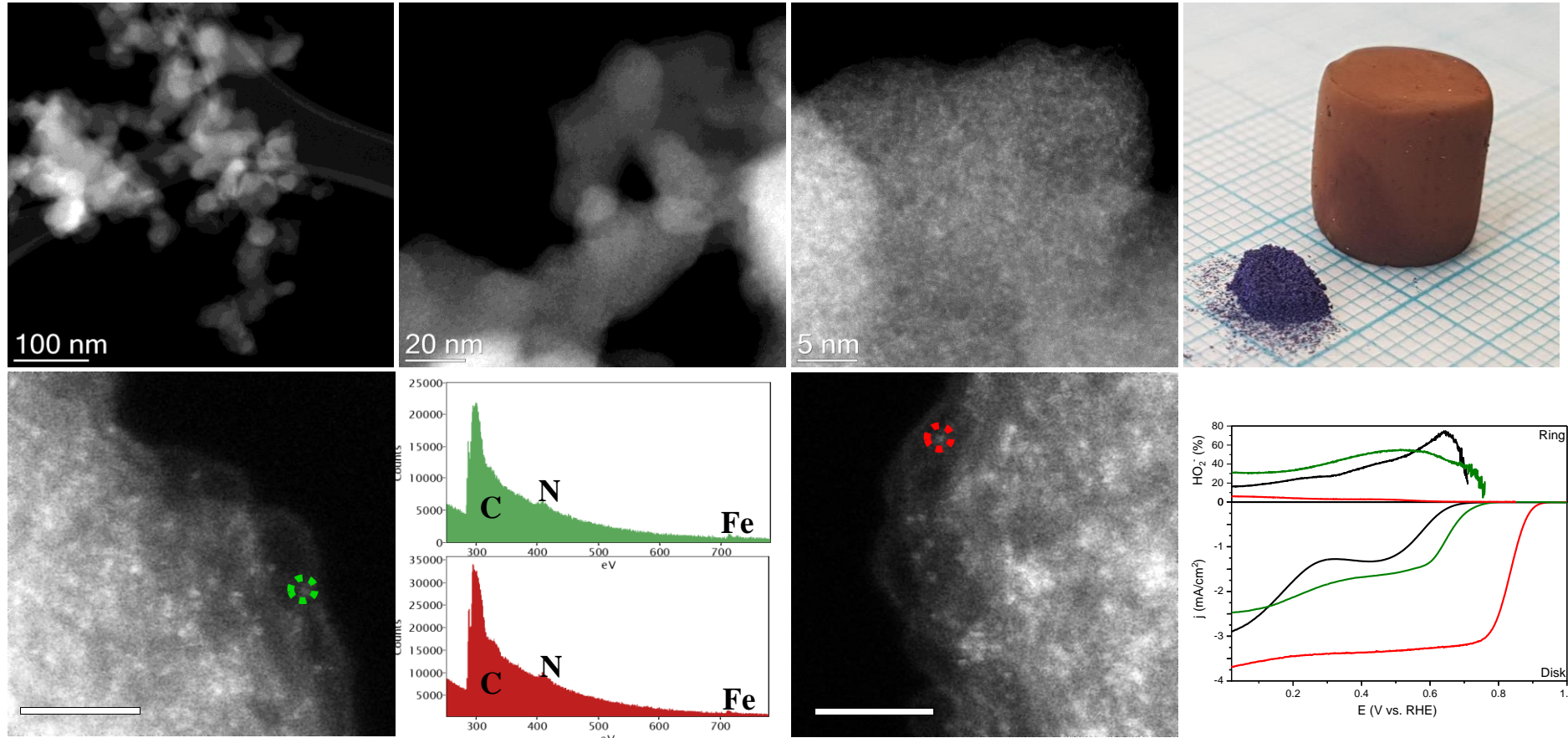


3D polymers of molecular PGM-free catalysts (**state-of-the-art** activity for its class)



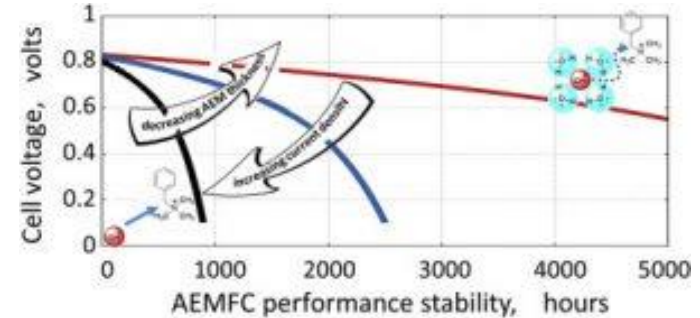
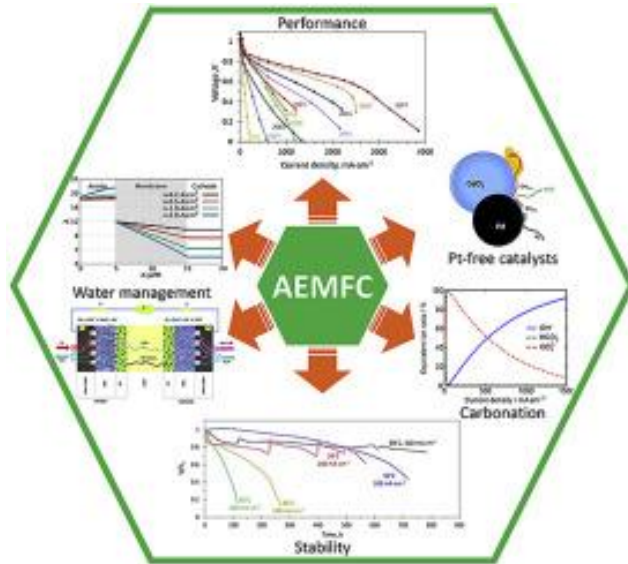
Design of Molecular PGM-free ORR Catalysts

Highly dense atomically dispersed PGM-free ORR catalysts: 1% wt Fe loading (3x higher than the state-of-the-art) (LE)

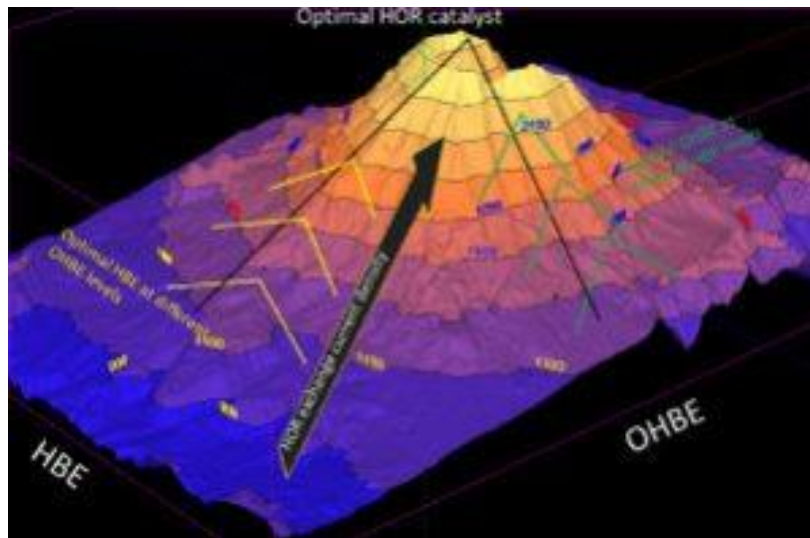


In collaboration with Los Alamos National Lab (PZ) and Oak Ridge National Lab (DC)

Development of Alkaline Membrane Electrolyte Fuel Cells



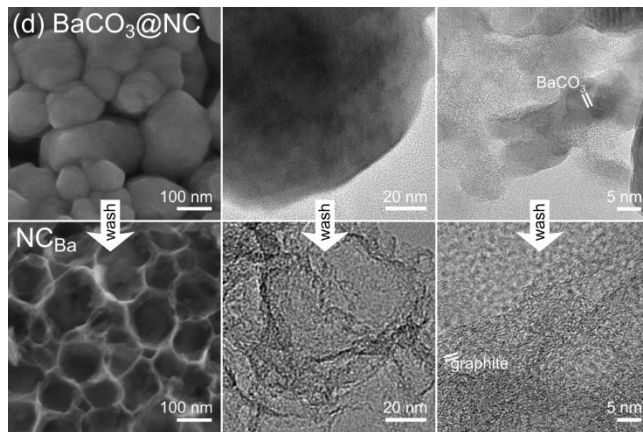
Predictive models for AEMFC life-time higher than 5000 h, suitable for automotive applications. (DD)



Unravelling mysteries of hydrogen electrooxidation in anion exchange membrane fuel cells: Models for the design of new HOR catalysts. (DD)

Design of Catalyst Layers: Improving Flow

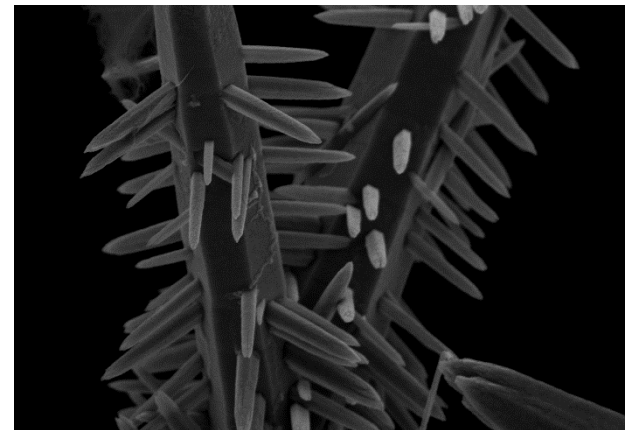
“Self-templating” of hierarchical porosity by alkaline-earth nanoparticles (DE)



Tuning pore size to:

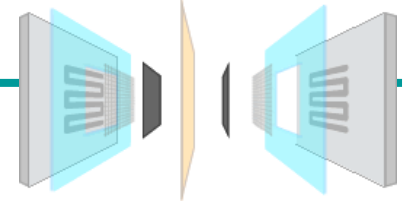
- Boost flow
- Affect oxygen reduction selectivity (2 / 4 electrons)

‘Lung’-inspired carbon porosity: templating by ZnO ‘trees’ (DE)

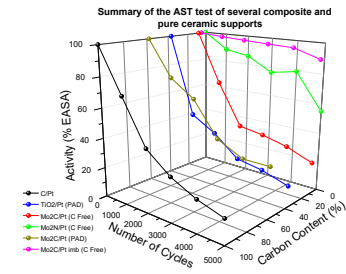
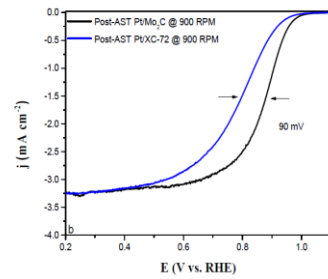
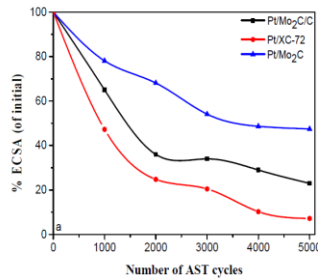
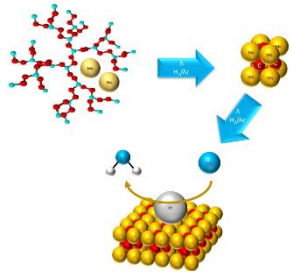


Studying effects of channel size and branching on **flow** in catalyst layer

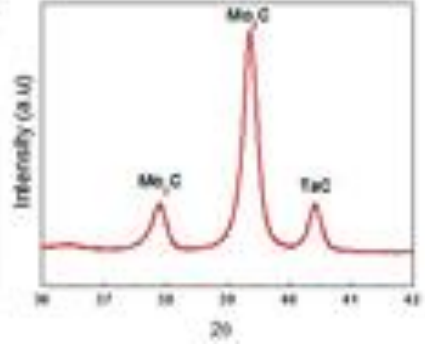
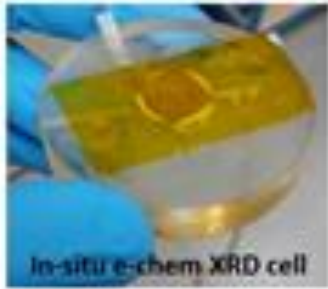
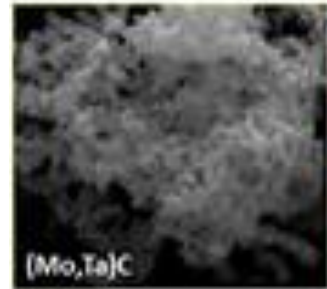
Achievements: Catalyst and Support Durability



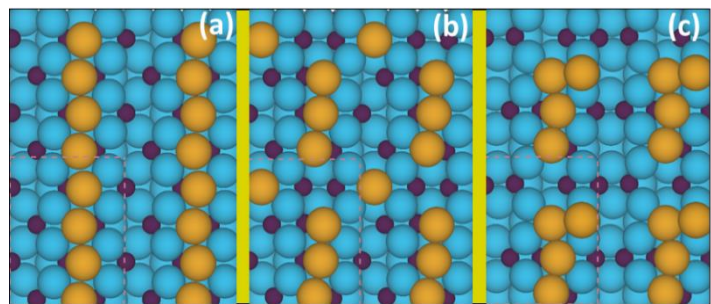
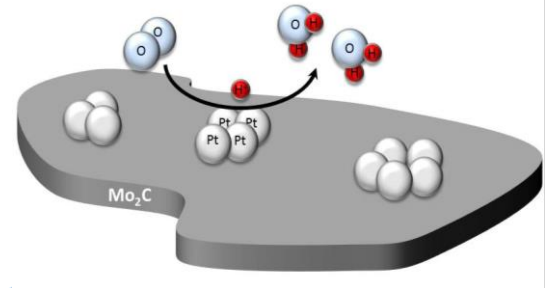
- Increase in more than **5x in support durability** with Pt/Mo₂C in half cell



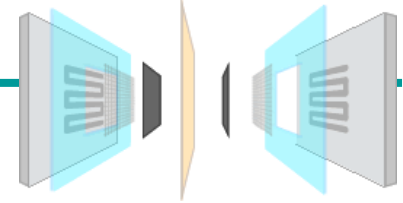
- Shown feasibility of SSM synthesis for **Mo₂C/TaC** composite cathode supports (**5000h** operation with **<10% degradation**)



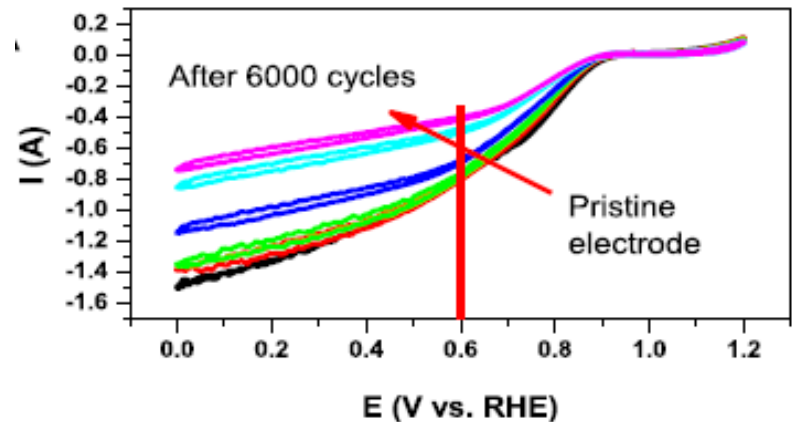
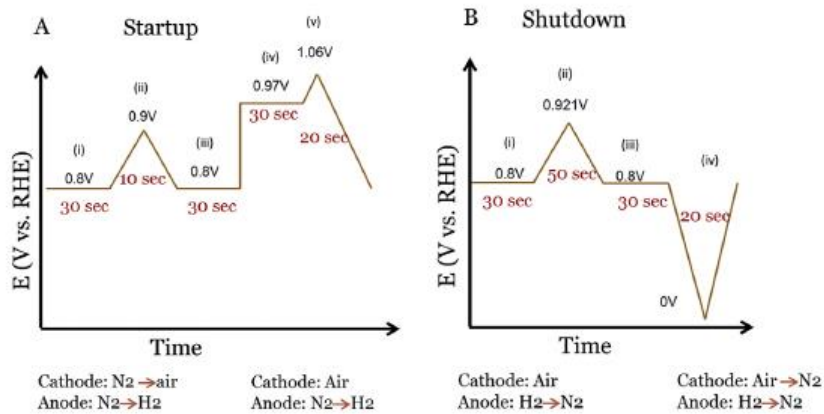
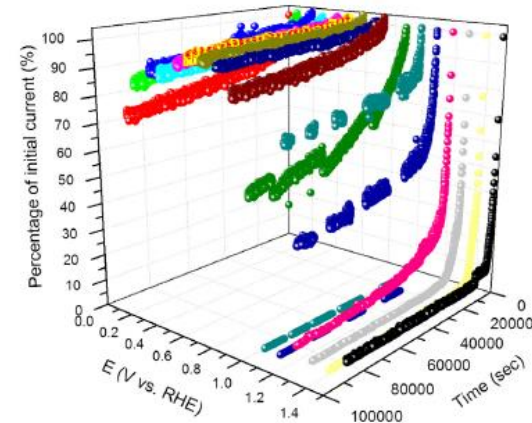
- Demonstrated an **unusual stability of Pt Nanorafts on Mo₂C surface**: a direct consequence of the disordered carbon arrangement on the Mo₂C surface



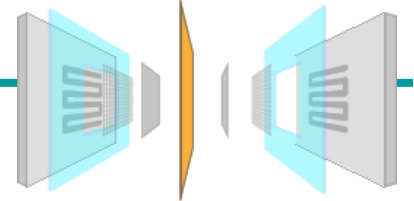
Achievements: Catalyst and Support Durability



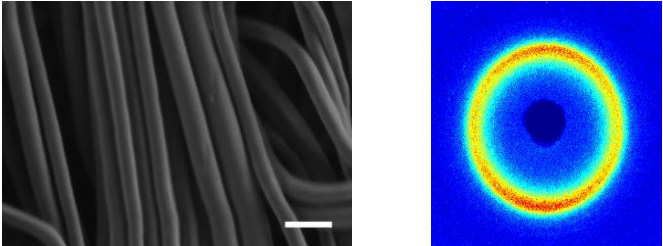
- Development of new **stability protocol for AEMs/AEs** that simulates the environment of an AEMFC in operation. (hopefully to be included soon into DOE's official protocols)
- Identification of the **main reason of AEMs/AEs degradation** during AEMFC in operation. (DOE target in the form of "cell stability >2000h test at 600mA/cm² at >60°C")
- Design of **methodologies for accelerated stress tests** and their implementation



Achievements: Membrane Durability

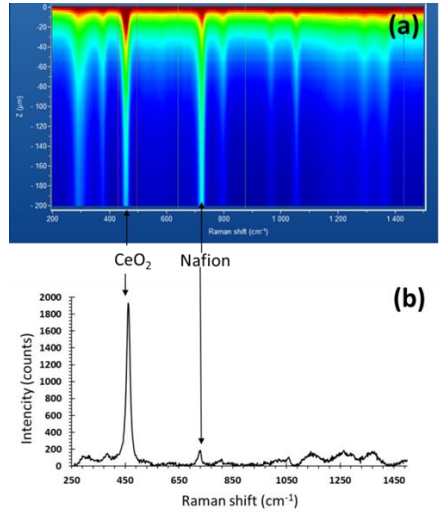


- Successful **electrospinning of sub-micron Nafion nanofibers**, and dual electrospinning of Nafion and PVDF nanofibers for enhanced stability and conductivity.

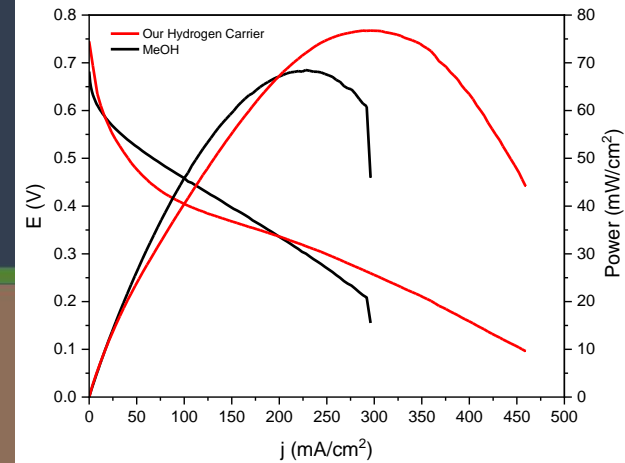


- Baseline for **PEM degradation studies**
- Studies of semi-interpenetrating polymer networks solid polymer electrolytes
- Studies of **pore-filling Nafion, synthesis and transport properties**

- The **effect of CeO₂ on H₂O₂ disproportionation** was proved and a new method for making thin coating of CeO₂ was developed (coating <20 μm was attained, no loss of conductivity, initial MEPC results were carried out).



Beyond conventional fuel cells: Reversible Fuel Cells for Decentralized Power



Collaborations in Israel



BAZAN GROUP



Israel Electric



Petroleum & Energy Infrastructures Ltd.
Oil Products Pipeline Ltd.



NL-IL Mini-Symposium on Hydrogen and Renewable Energy



אוניברסיטת
בר־אילן
Bar-Ilan University



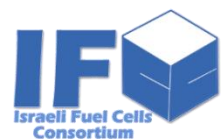
הטכניון
מכון טכנולוגי
לישראל



מרכז לאומי לאנרגיה בת קיימא

NISE | National Institute for Sustainable Energy

יא אלול ה'תש"פ | 1.9.20



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Thank You!