



INSTITUTE OF ELECTROCHEMISTRY AND
ACADEMICIAN EVGENI BUDEVSKI ENERGY SYSTEMS

Electrochemical Studies of Monolithic Dual Membrane Fuel Cell in Reversible Mode

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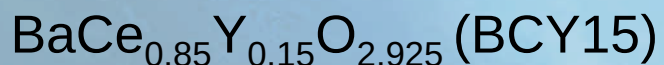
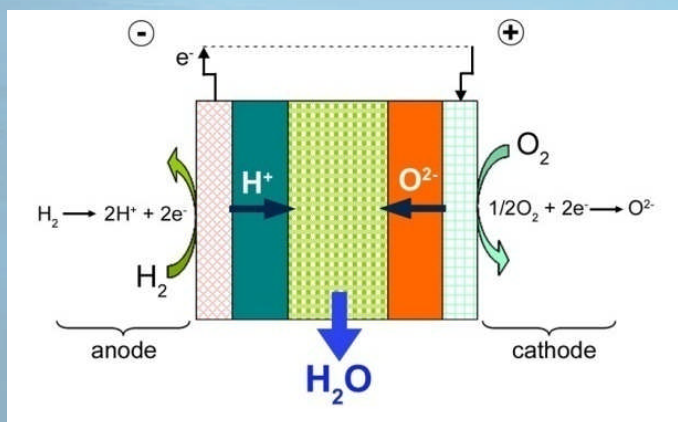
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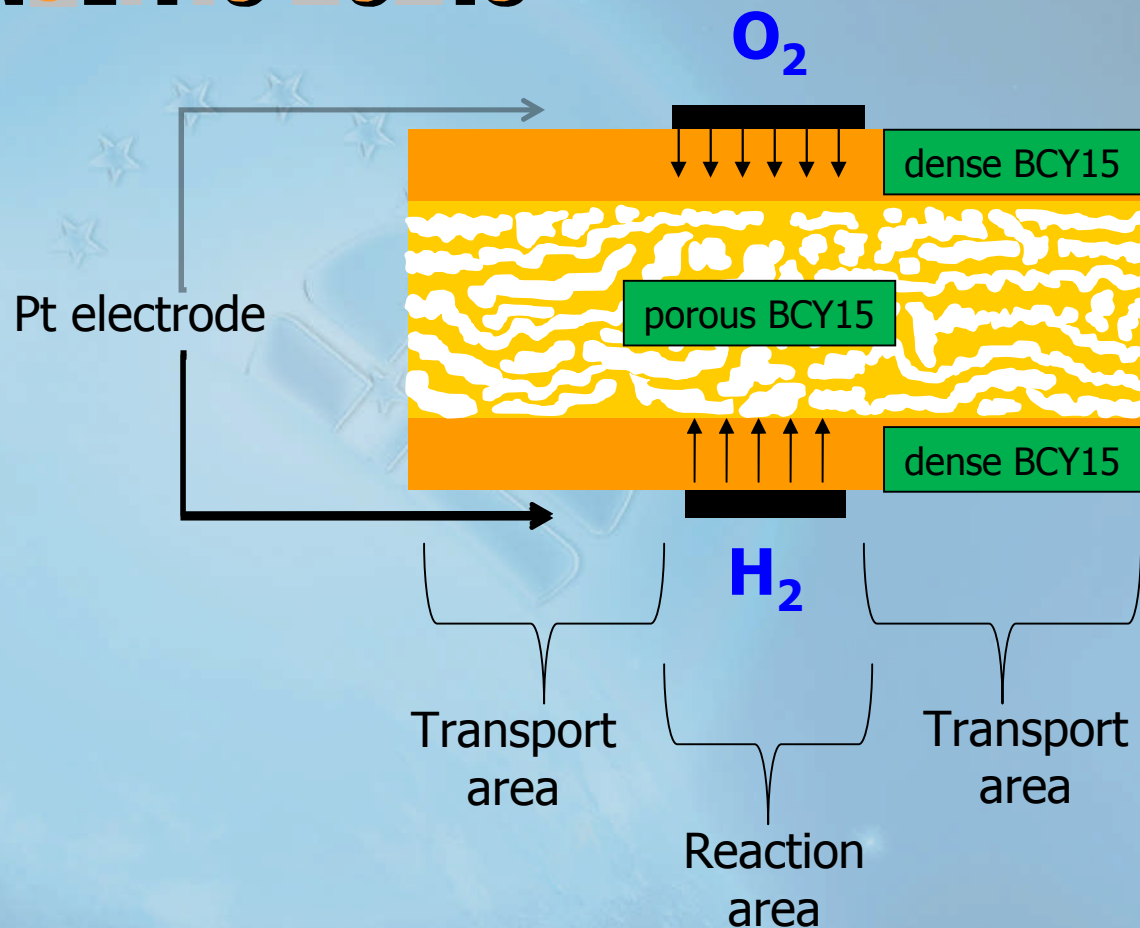




MONOLITIC BCY15

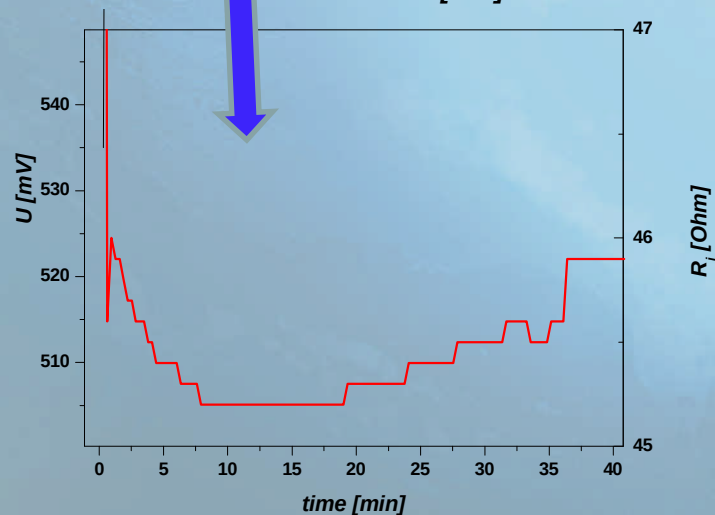
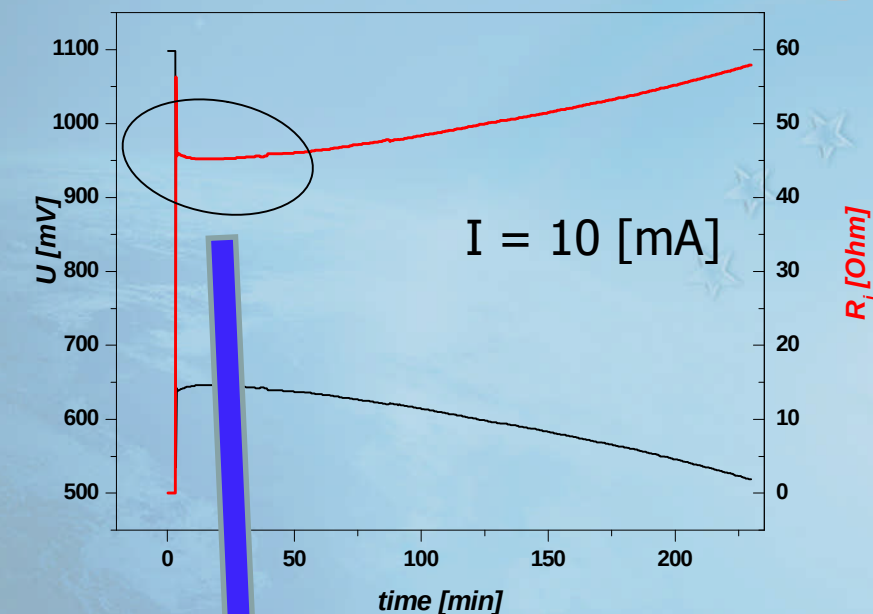


- ✦ The fuel is not diluted
- ✦ The water produced in the central membrane can be re-used for hydrogen production





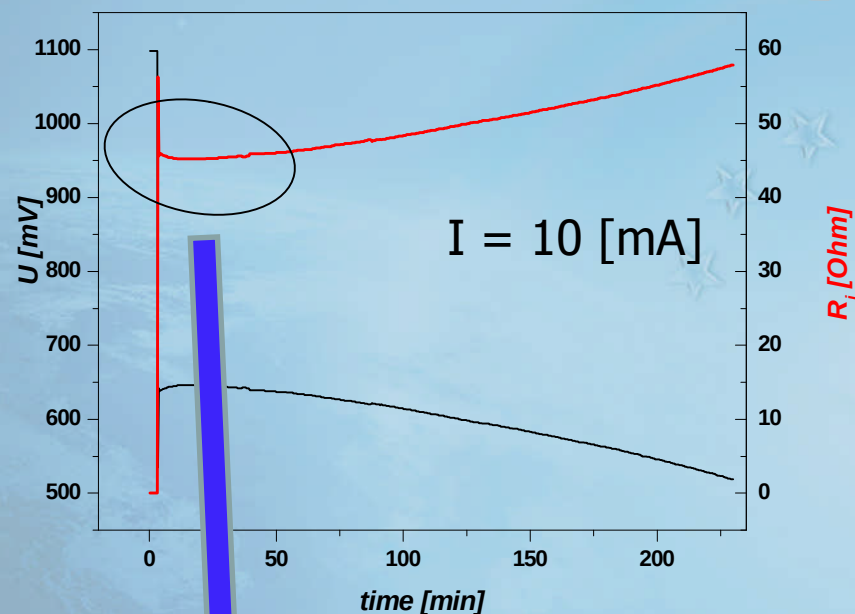
Fuel Cell Mode



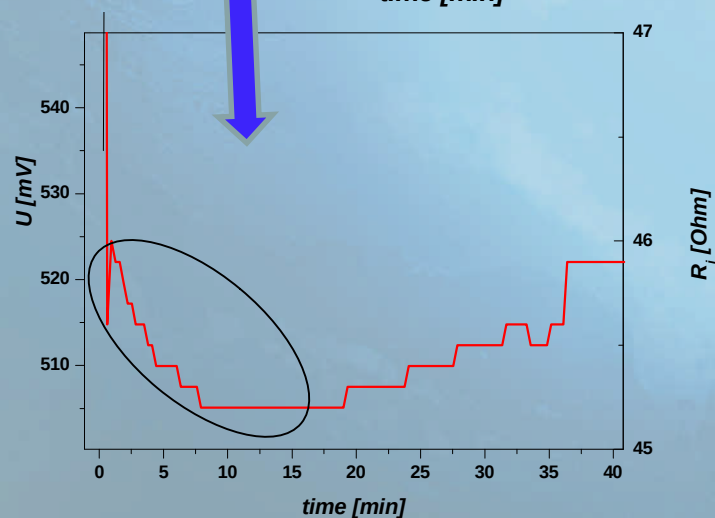
The formation of H_2O film improves grains contacts



Fuel Cell Mode



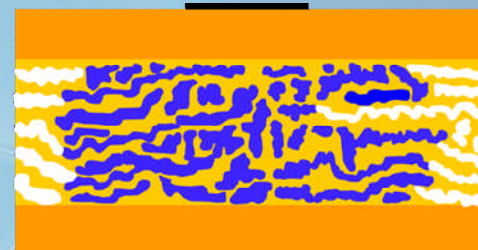
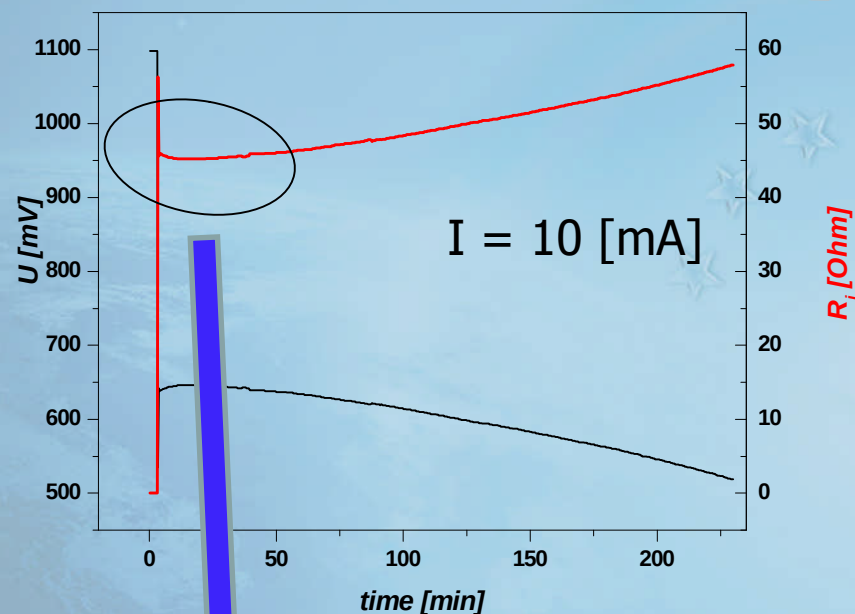
Water formation in the reaction area



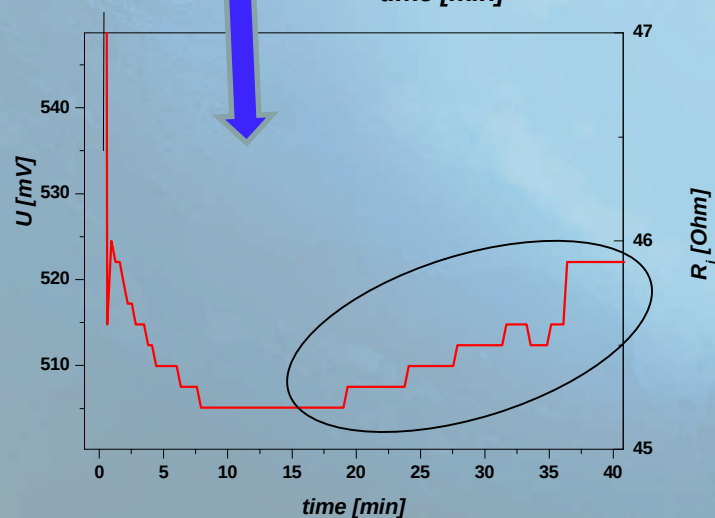
The formation of H_2O film improves grains contacts



Fuel Cell Mode



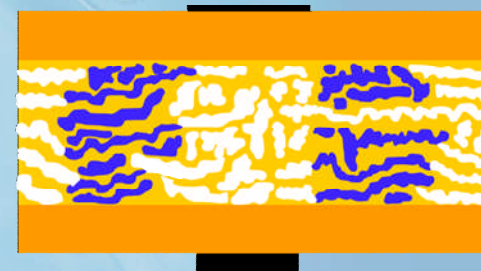
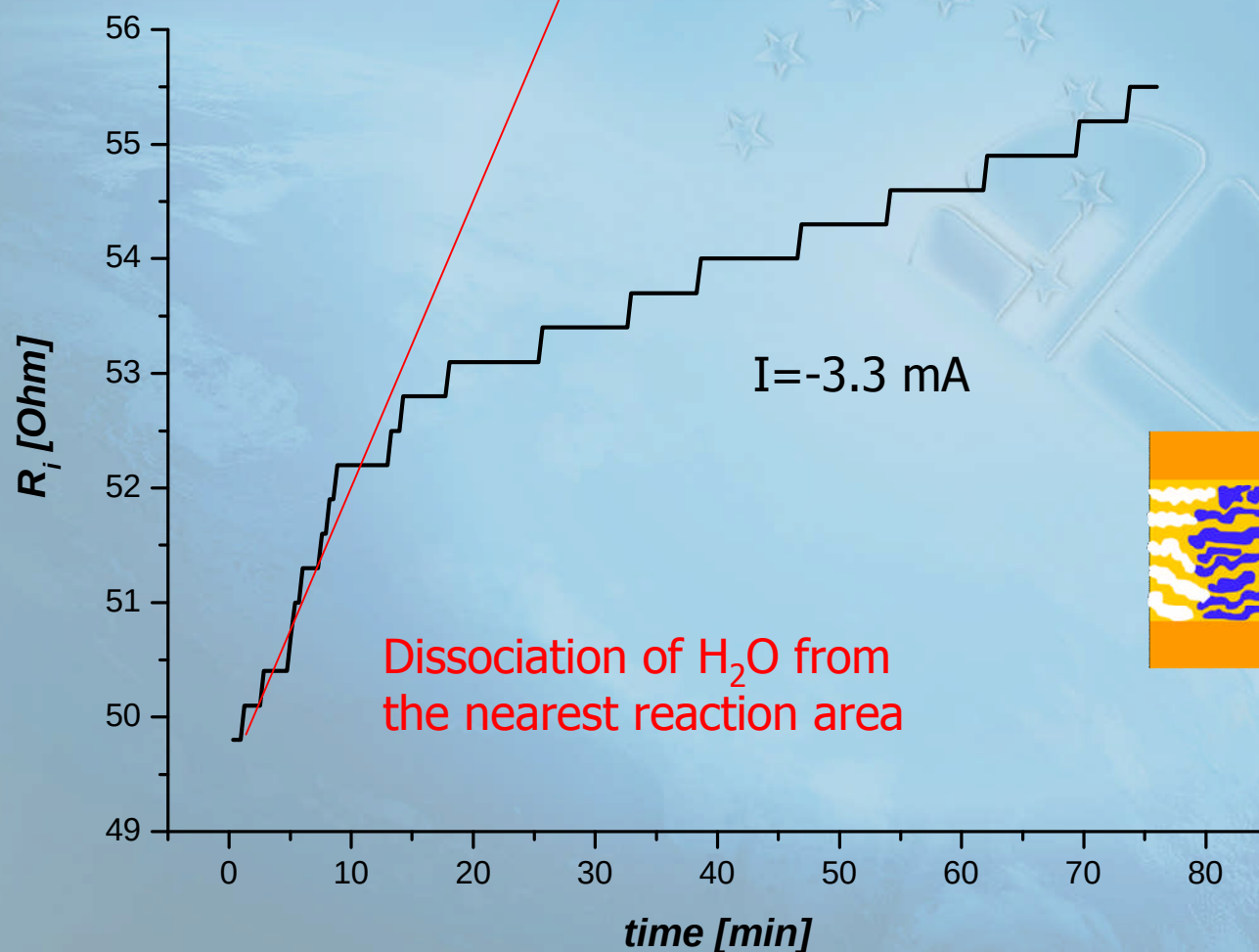
Transport of water in the pores of the transport area



The formation of H_2O film improves grains contacts

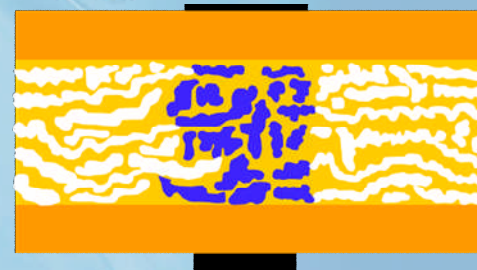
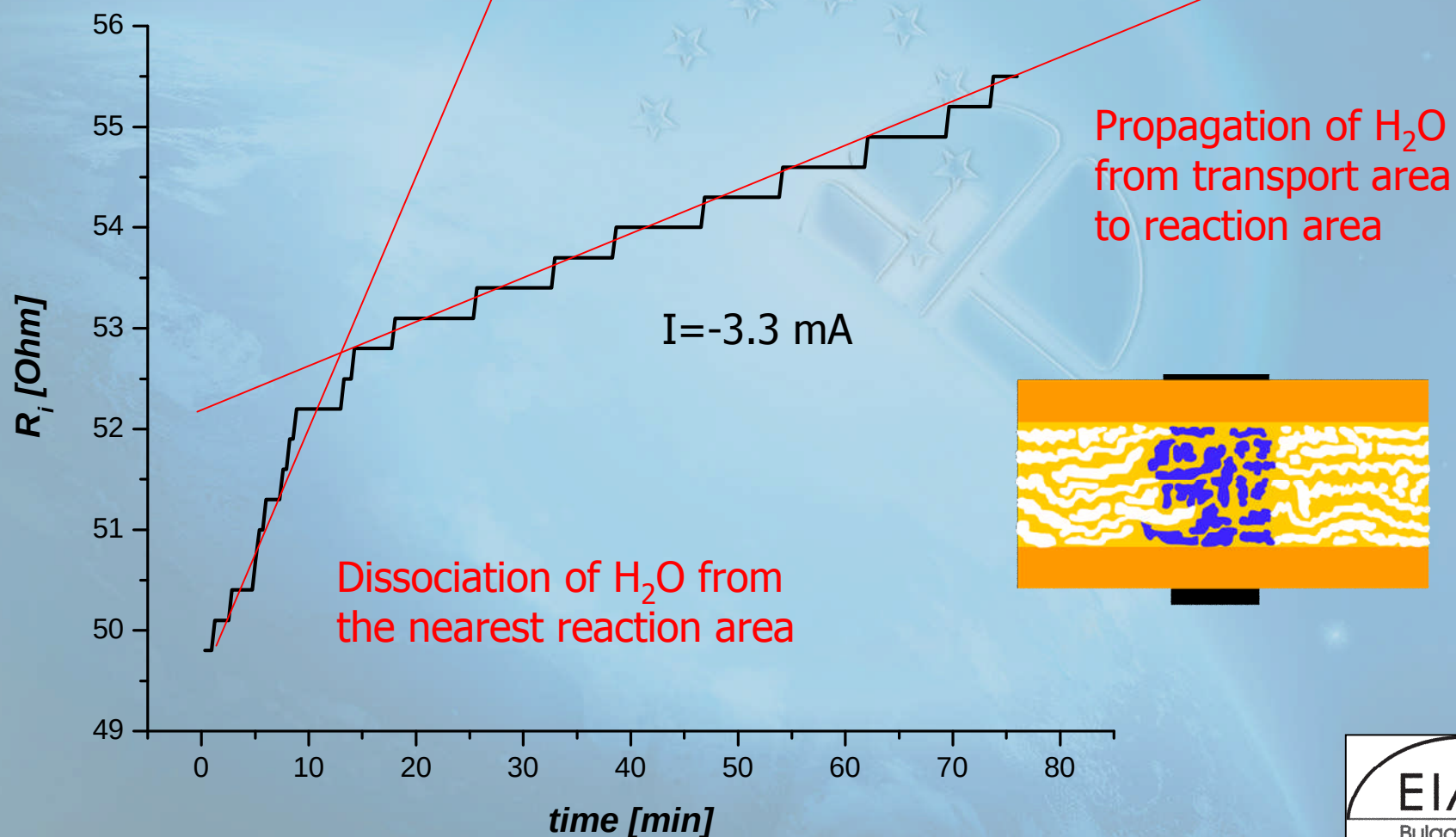


Electrolyser mode





Electrolyser mode





CONCLUSIONS

In fuel cell mode:

R_i decreases at the beginning and then increases
~ 2 times, which corresponds to:

1. Formation of H_2O film, which increases the contacts between the BCY15 grains;
2. Propagation of the H_2O film to the transport area;
3. Filling of the transport area with H_2O film;



In electrolyzer mode:

1. The process starts with dissociation of water from the nearest layers of the reaction area;
2. Propagation of H_2O from the transport area to the reaction area.

∴ BCY15 is a suitable electrolyser material since the water dissociation occurs without application of a special catalyst for enhancement of water splitting



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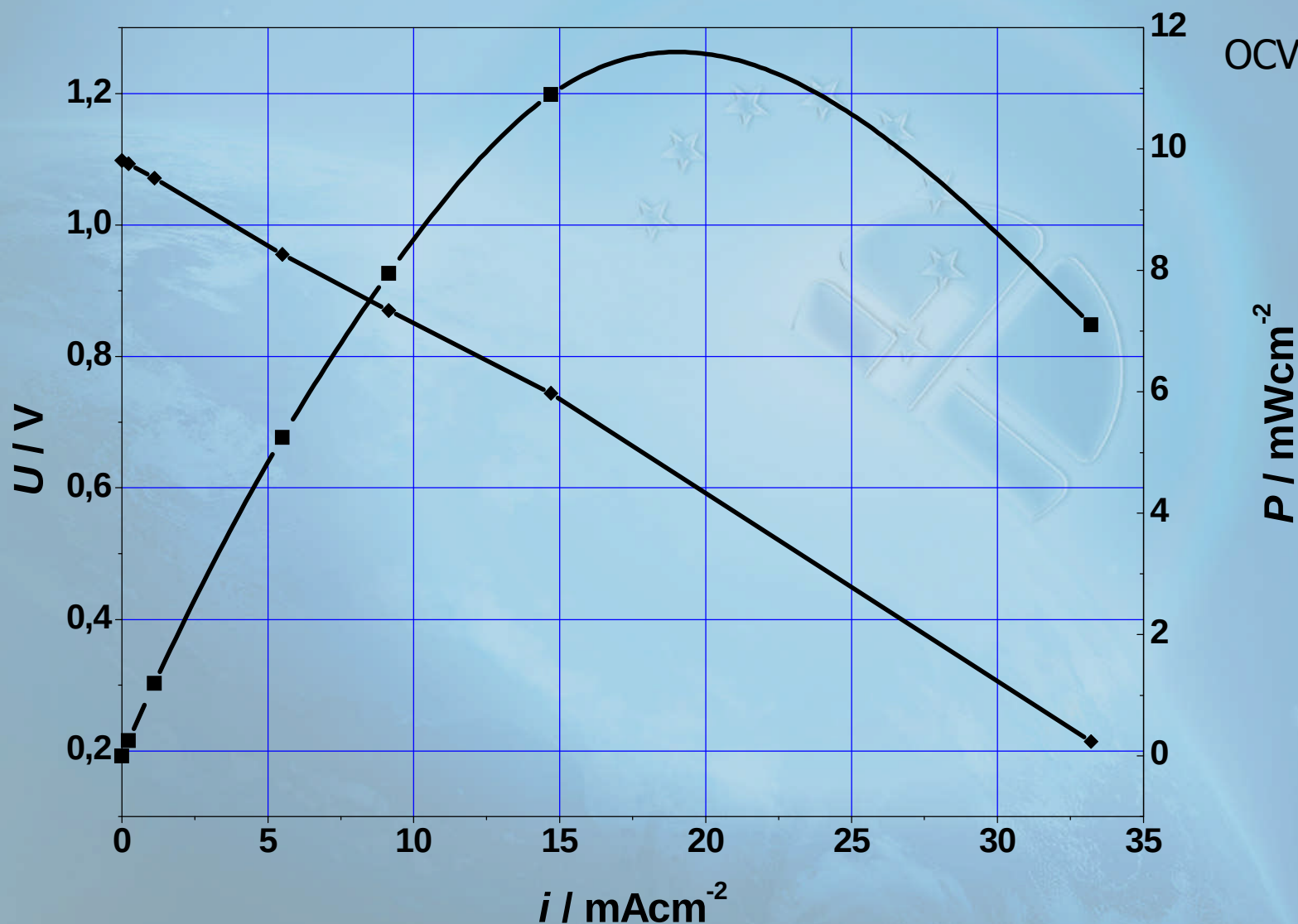




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$$P_{\max} = 11.6 \text{ [mW/cm}^2\text{]}$$

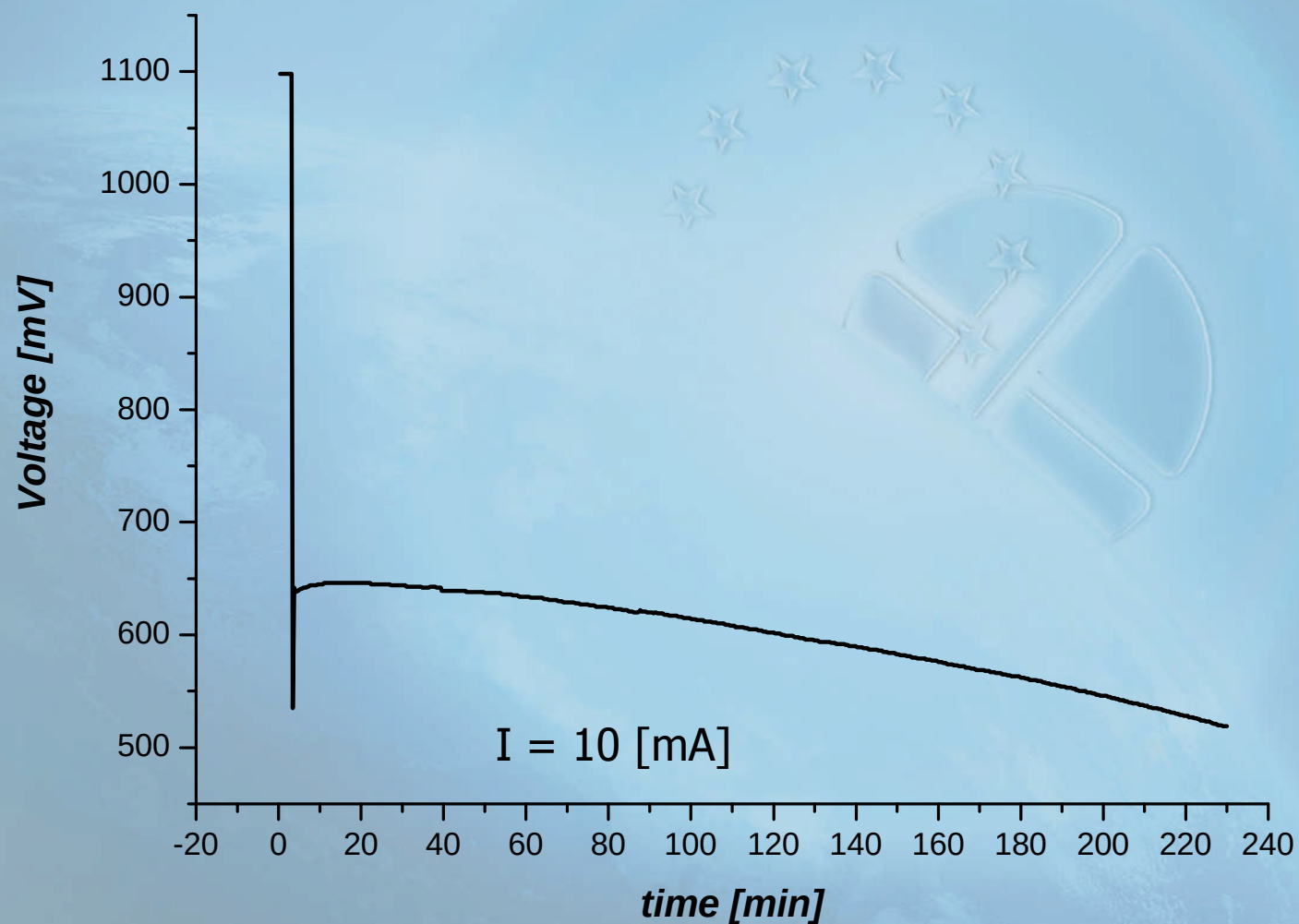
$$\text{OCV} = 1.098 \text{ [V]}$$





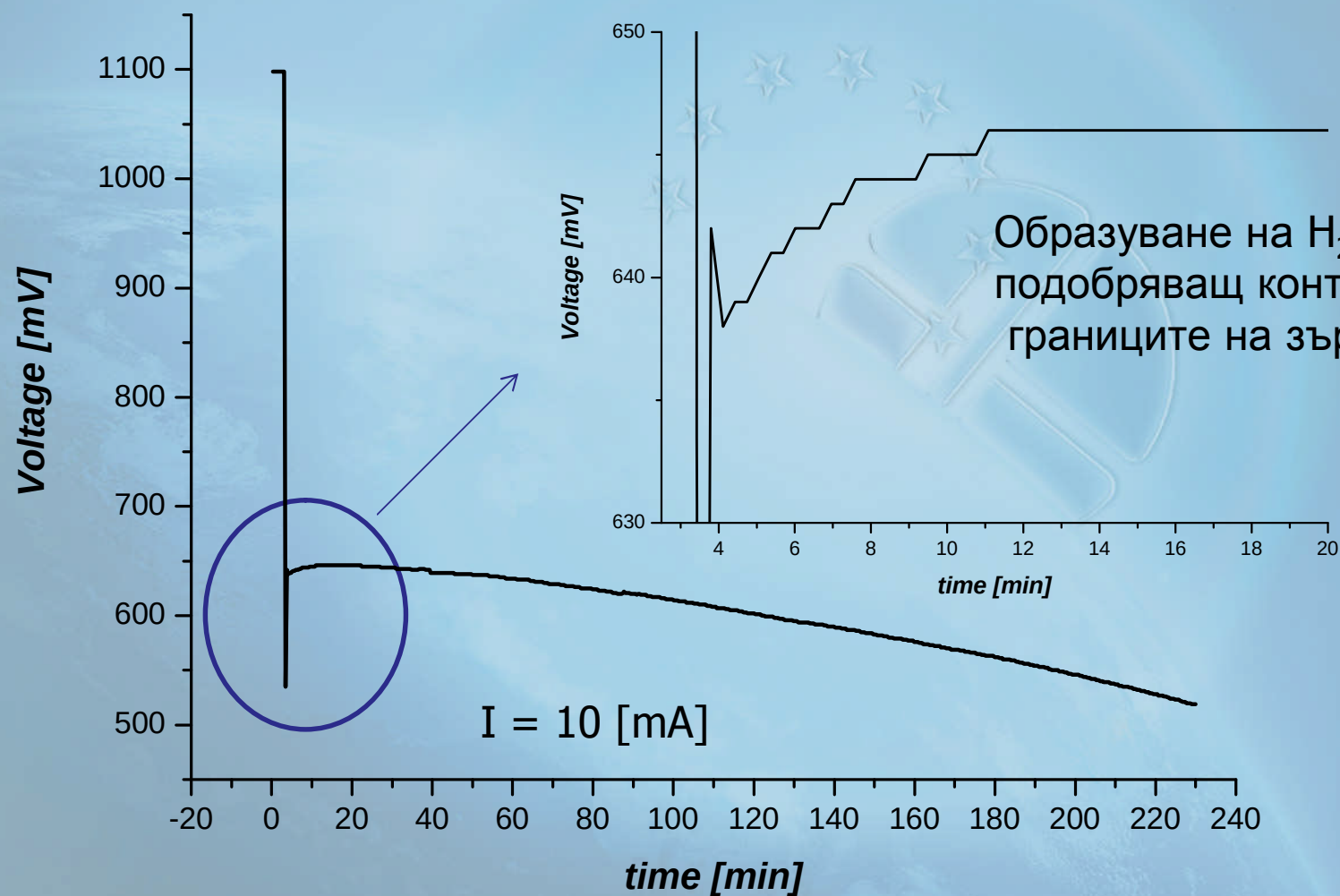
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Режим на горивна клетка





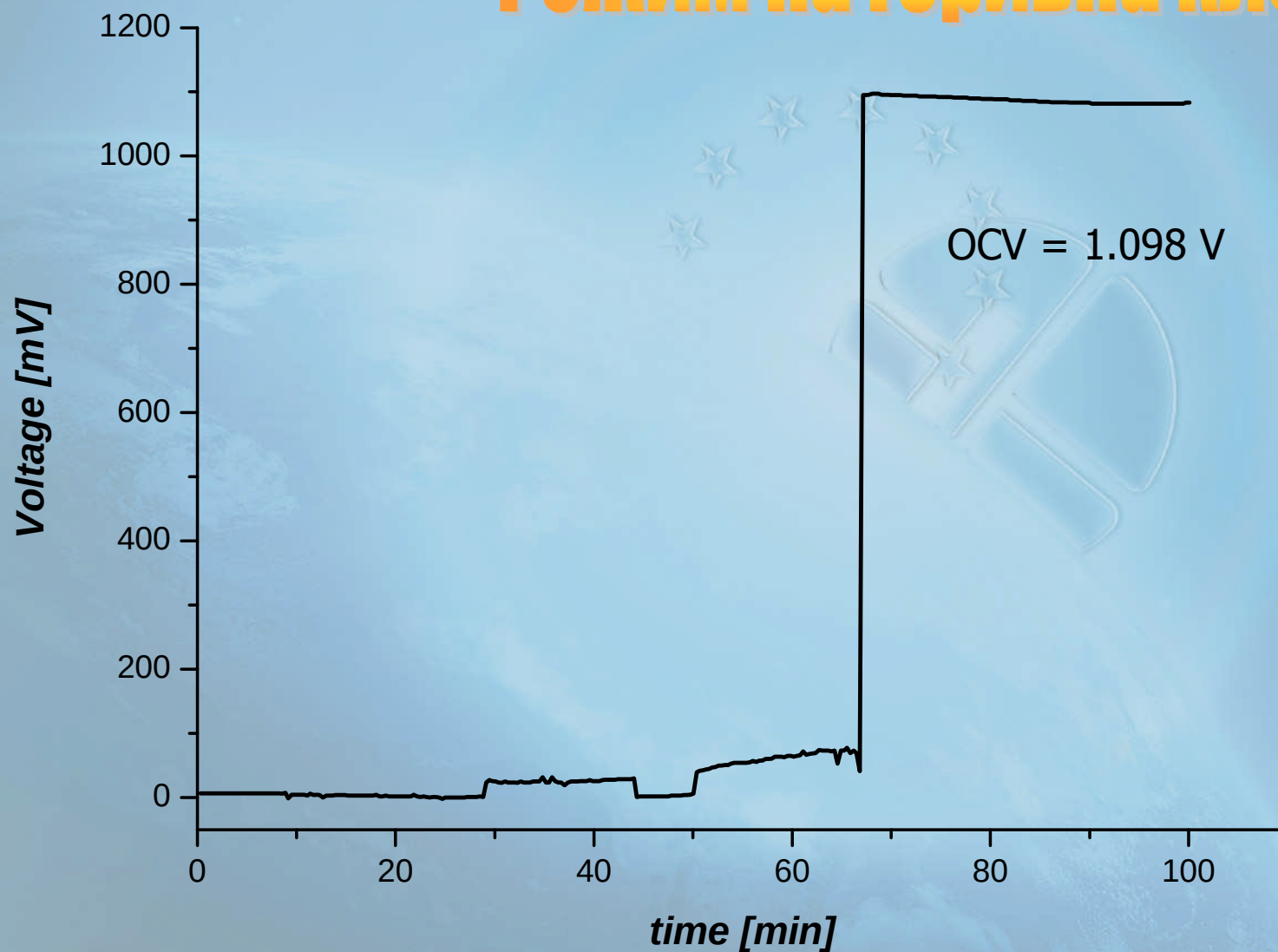
Режим на горивна клетка





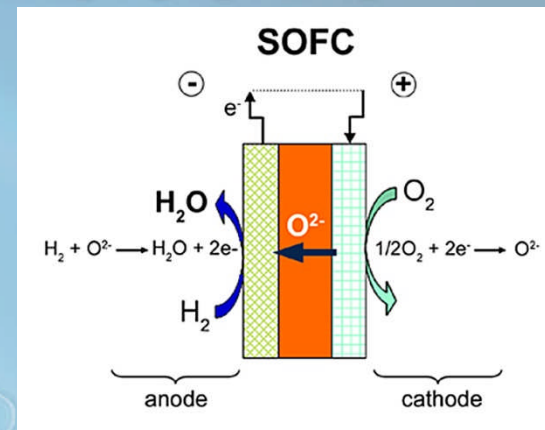
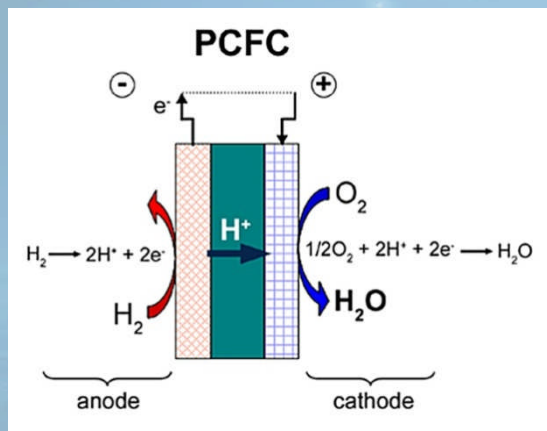
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Режим на горивна клетка





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Геометрични размери/микроструктура:

Условия на експеримента:

$$S = 3.203 \text{ [cm}^2\text{]}$$

$$V_{\text{проба}} = 0.096 \text{ [cm]}$$

$$T = 600 \text{ [}^{\circ}\text{C]}$$

$$I_{\text{FC}} \sim 10 \text{ [mA]}$$

$$\text{Време на натоварване} \sim 6 \text{ [h]}$$

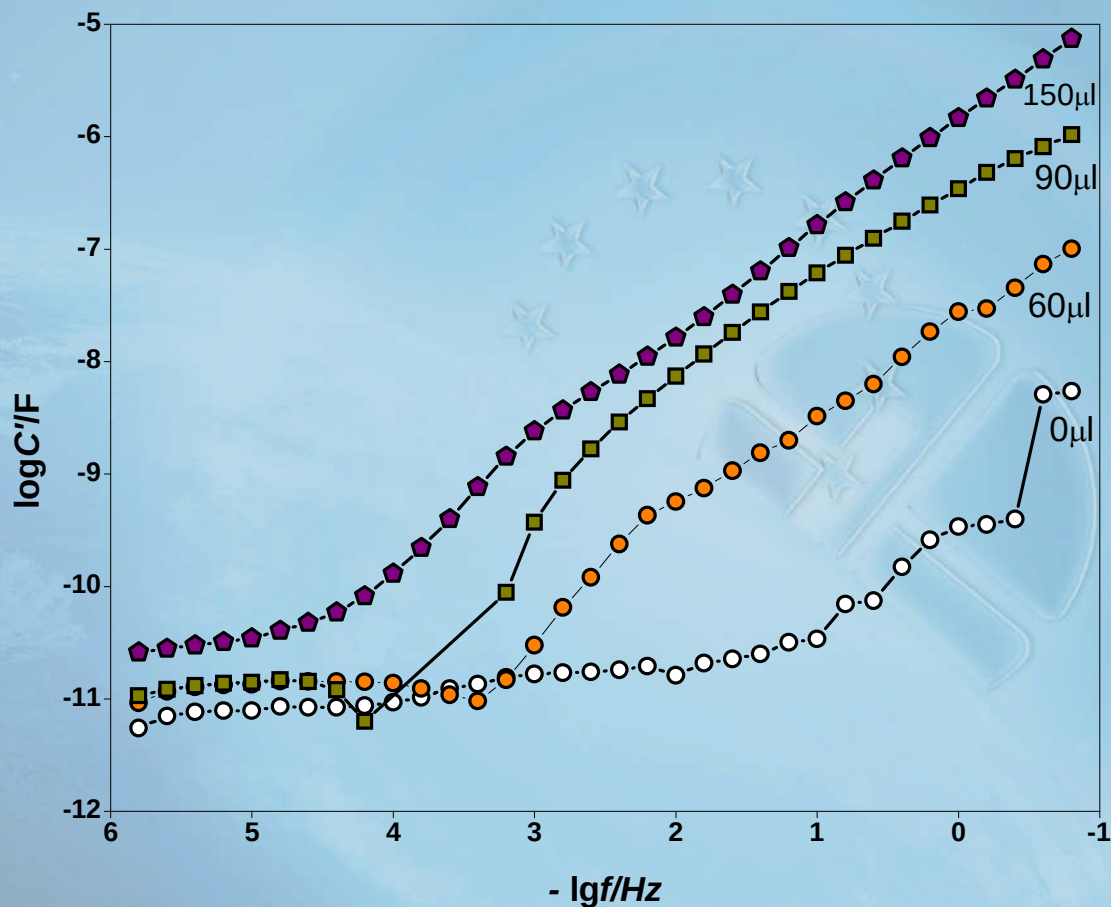
$$\text{End voltage} \quad 0.2 \text{ [V]}$$

$$h_{\text{централна мембрана}} = 0.03 \text{ [cm]}$$

$$\text{порестост} = 30 \%$$

$$\bullet \bullet \quad V_{\text{пори}} = 0.0045 \text{ [cm}^3\text{]}$$

След 6 часа при 10 [mA], $Q = 60 \text{ [mAh]}$;

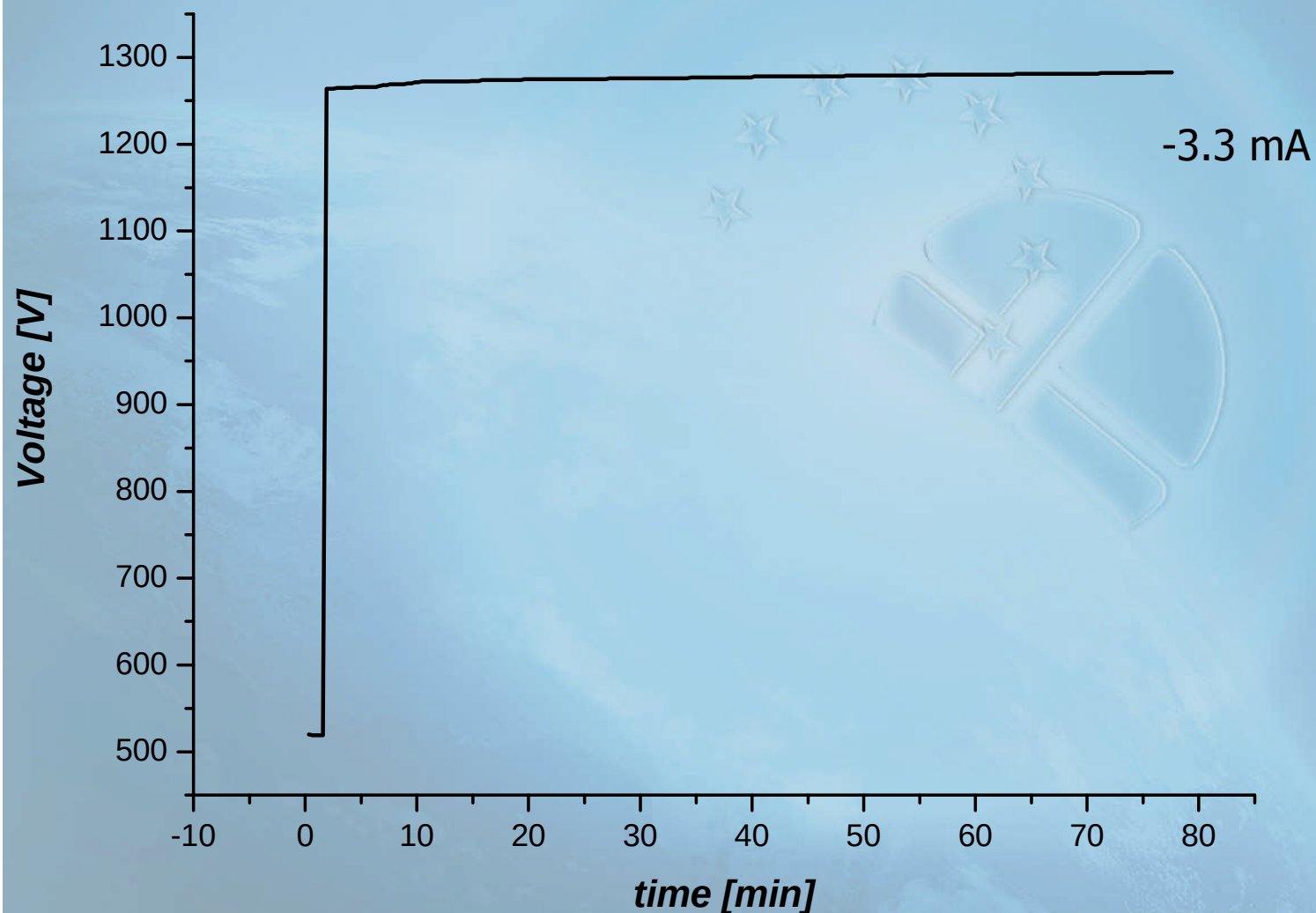


Честотна зависимост на C' при различно омекряне на монолитна мембрана от BCY15 с 30% пористост и порообразовател графит.



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Режим на електролизьор





- Изследване поведението на монолитна клетка от BSY15 в два режима на работа: горивна клетка/електролизьор, при прав ток.



Ø проба = 2.02 cm

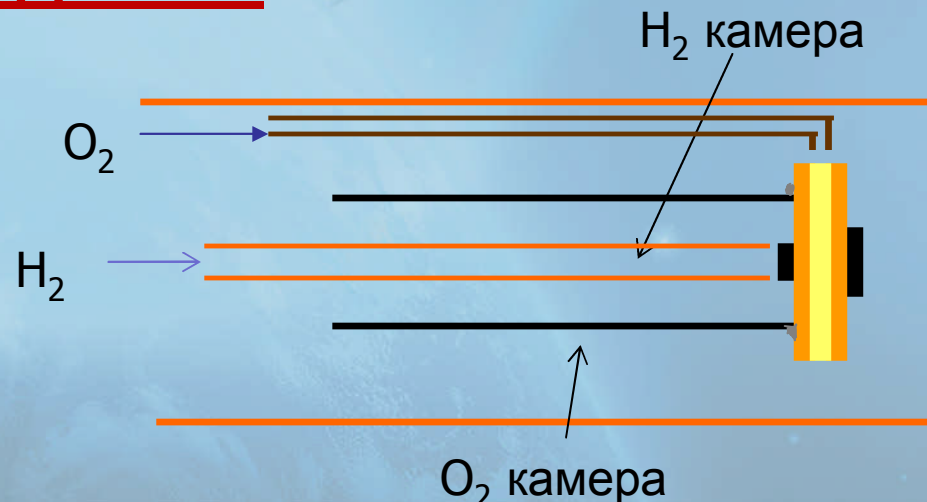
h проба = 0.1 cm

МОНОЛИТНА КЛЕТКА:

Pt/BSY_{плътен} 15 BSY15_{порест} BSY15_{плътен}/Pt

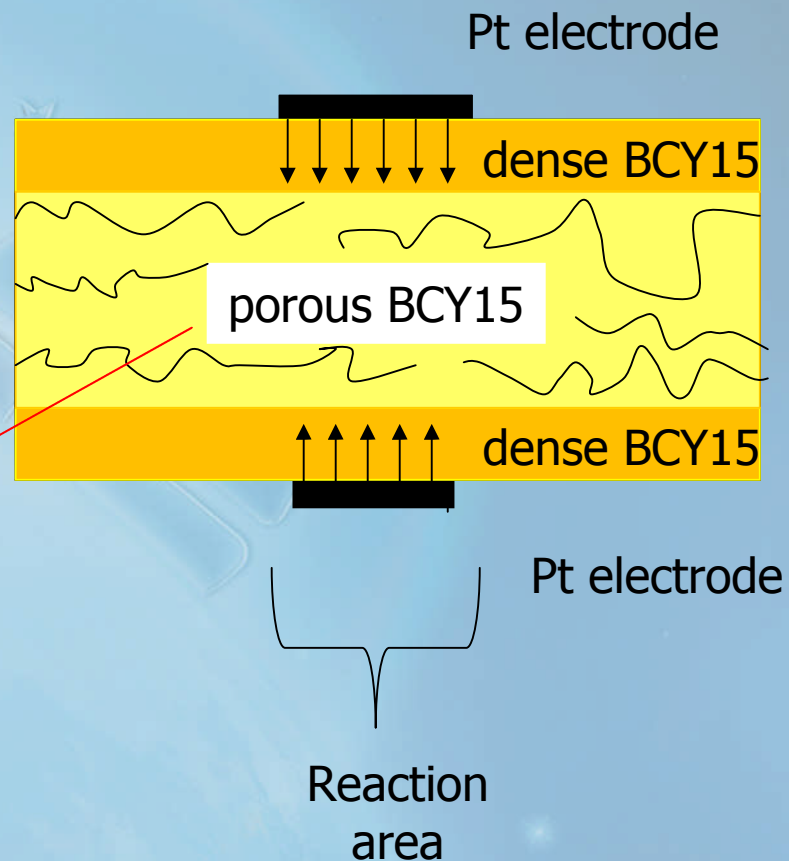
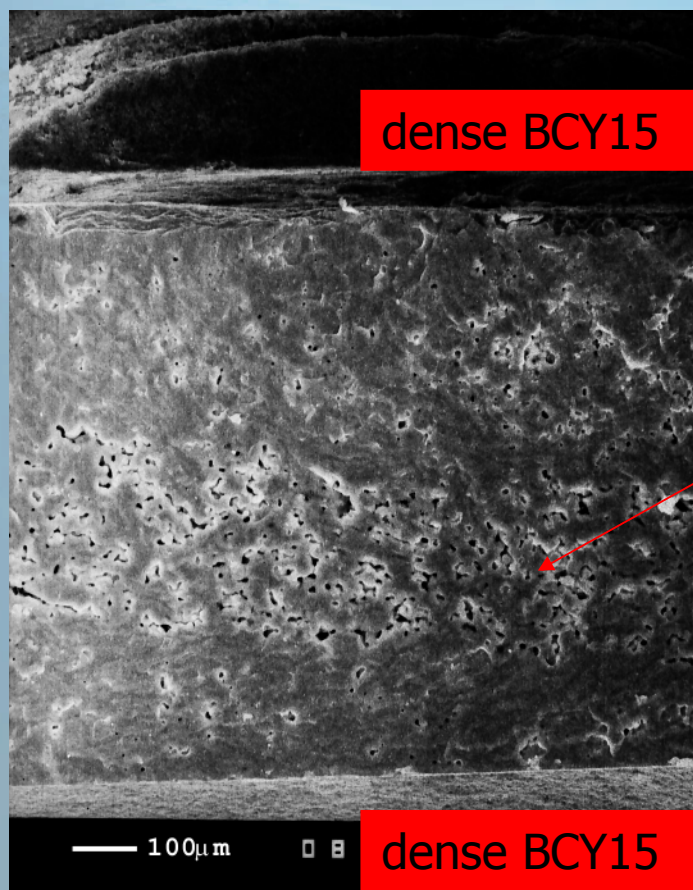
Оборудване:

- Правотокова пещ





MONOLITIC BCY15





Fuel Cell Mode

$I = 10 \text{ [mA]}$

