# Electrocatalysis in confinement: metal-organic frameworks for oxygen reduction

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# Propositions

*Accompanying the thesis*

**Electrocatalysis in Confinement: Metal-Organic Frameworks for Oxygen Reduction**

1. Whether the catalyst should be immobilized on the linker, attached to the node or embedded in the pore of the metal-organic framework should be determined based on the mechanisms of activation and deactivation of the catalyst. (Chapter 1 and 2).

2. Mass-transport limitations of reactants and products can directly or indirectly affect the selectivity of a catalytic reaction in the pores of a metal-organic framework. (Chapter 2)

3. A molecular catalyst immobilized in a MOF may not function the same way as it does in homogeneous solution, so its catalytic mechanism should be verified after incorporation into the MOF (Chapter 1-3, and M. Langerman, D. G. H. Hetterscheid, *Angewandte Chemie International Edition* **2019**, *58*, 12974–12978)

4. Increasing the fraction of electrochemically addressable moieties does not necessarily result in higher catalytic current densities. (Chapter 4)

5. Electron-transfer mechanisms occurring during rapid voltammetry experiments are not necessarily representative for electron-transfer mechanisms occurring during charging and discharging of the entire MOF structure. (Chapter 5)

6. Mass transport and electron transport in MOFs cannot be considered as two separate phenomena, even if they can be quantified separately. (Chapter 2, Chapter 4, A. T. Castner, H. Su, E. Svensson Grape, A. K. Inge, B. A. Johnson, M. S. G. Ahlquist, S. Ott, *J Am Chem Soc* **2022**, *144*, 5910–5920, and P. J. Celis-Salazar, M. Cai, C. A. Cucinell, S. R. Ahrenholtz, C. C. Epley, P. M. Usov, A. J. Morris, *J Am Chem Soc* **2019**, *141*, 11947–11953)

7. Metal-organic frameworks combine the advantages and disadvantages of both homogeneous catalysis and heterogeneous catalysis. (A. S. Rosen, J. M. Notestein, R. Q. Snurr, *ACS Catal* **2019**, *9*, 3576–3587 and this thesis)

8. Investigating the direct interplay between electron transport throughout metal-organic frameworks and catalytic reactions occurring simultaneously within these frameworks will advance the field significantly. (A. Johnson, A. Bhunia, H. Fei, S. M. Cohen, S. Ott, *J Am Chem Soc* **2018**, *140*, 2985–2994, A.T. Castner, B.A. Johnson, S.M. Cohen, S. Ott**.** *J Am Chem Soc* **2021**, 143, 21, 7991–7999)

9. When your research gets stuck, a long holiday can put work in motion again in unexpected ways.

10. To do a PhD is to work as a scientist, teacher, artist, project manager and editor while being viewed as a student.

11. Friends at work are the most stable catalysts to a successful PhD.

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