

## Design and Optimization of Hollow PtNi Nanostructures for the Oxygen Reduction Reaction

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**Keywords:** Proton-exchange membrane fuel cell, hollow nanoparticles, nanoscale Kirkendall Effect.

During the United Nations Conference on Climate Change held in Paris in 2015, agreement was reached by 195 states to limit the global average temperature increase to 1.5 °C above pre-industrial level. To achieve this ambitious objective, increasing the efficiency of conventional energy systems and developing renewable energy sources is required. Proton exchange membrane fuel cells (PEMFC) have the potential to power future portable, automotive or stationary devices, however kinetic, stability and cost limitations remain on the cathode side where the oxygen reduction reaction (ORR) takes place.

In this contribution, we report our most recent findings on the synthesis, ORR activity and stability of porous hollow PtNi/C nanoparticles developed at LEPMI. We firstly shed fundamental light on their mechanism of formation, then focus on their electrocatalytic activity for the ORR and their stability in simulated PEMFC operating conditions. The enhancement in mass and specific activity for the ORR is 6-fold and 10-fold on the best porous hollow PtNi/C nanocatalyst (Ni content 15 at. %) relative to standard solid Pt/C nanocrystallites of the same size, respectively. After 5,000 potential cycles between 0.60 and 1.00 V vs. RHE at  $T = 80^{\circ}\text{C}$ , combined physical, chemical and electrochemical results show that losses in ORR activity are related to weakening of strain and ligand effects associated with the dissolution of Ni atoms. However, the initial catalytic advantage of hollow over solid PtNi/C nanoparticles is maintained during the accelerated stress test. Investigations on various PtNi nanostructures indicate that implementing structural disorder in ORR nanocatalysts is a new direction to look at to improve sustainably the ORR kinetics.

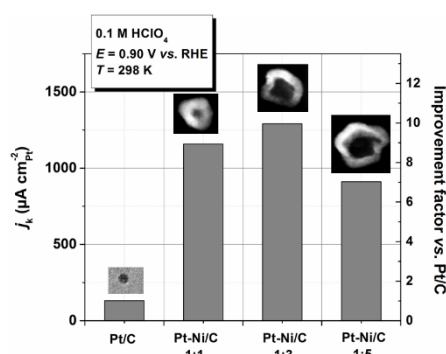


Fig. 1 : Specific activity for the ORR determined from steady-state  $I-E$  curves in  $\text{O}_2$ -saturated 0.1M  $\text{HClO}_4$ .

### REFERENCES

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