Pt/Magnetic Fe Oxide Nanoparticles for ORR Electrocatalysis Synthesized by Gas-Diffusion Electrocrystallization (GDEX)

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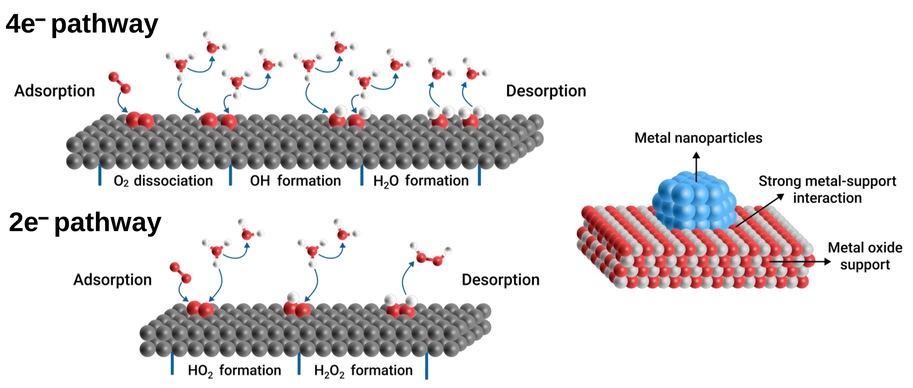
INTRODUCTION

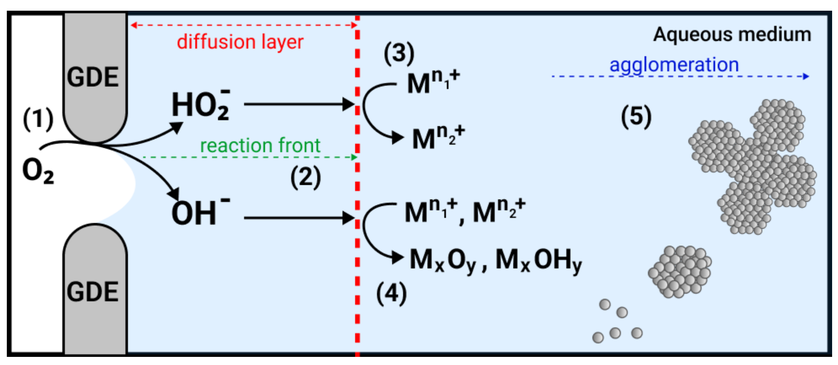
The oxygen reduction reaction (ORR) is vital for fuel cell devices. ORR occurs via two pathways: a two-electron route producing hydrogen peroxide and a four-electron route forming water. A surface engineering approach known as strong precious metal–metal oxide interaction (SPMMOI) can be used to enhance ORR efficiency and stability. This method, stemming from strong metal–support interaction (SMSI), adjusts the precious metal's electron structure, enhancing ORR activity and optimizing oxygen adsorption energy. Additionally, metal oxides offer corrosion resistance, addressing stability concerns in carbon-based catalysts. We introduced the Gas-Diffusion Electrocrystallization (GDEx) method, combining metal oxide and precious metal synthesis to synthesize Pt/Fe oxide nanoparticles (Pt-IONPs), a model material, and evaluated their ORR activity.



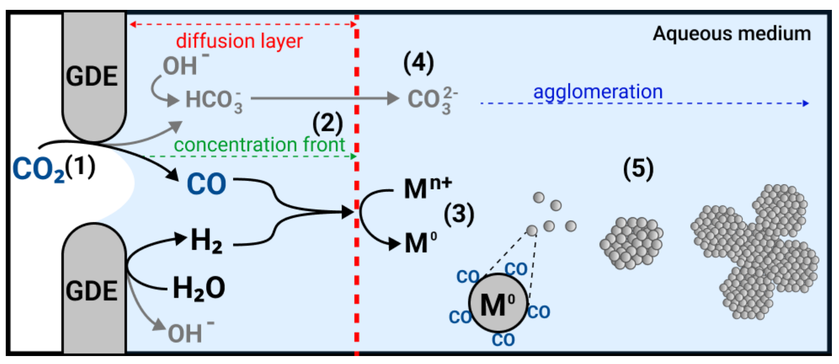
Gas-Diffusion Electrocrystallization (GDEx)

Electrochemical process for the recovery of metals from liquid streams and synthesis of metallic and/or metal oxide nanoparticles (NPs), where reducing or oxidizing agents are produced in-situ during the electrochemical reduction (or oxidation) of a gas in a gas-diffusion electrode (GDE).

Synthesis of metal oxide NPs

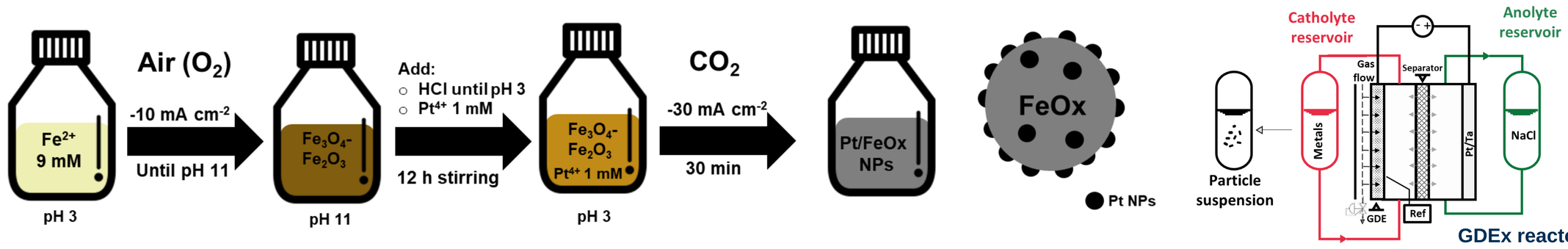


Synthesis of noble metal NPs



Our publications about GDEx

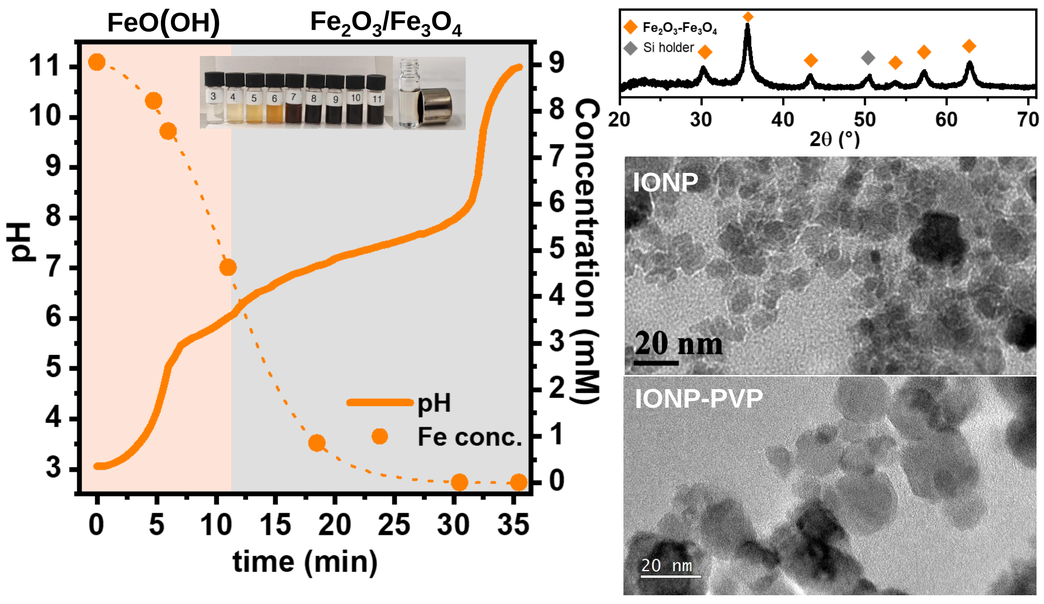
SYNTHESIS STRATEGY



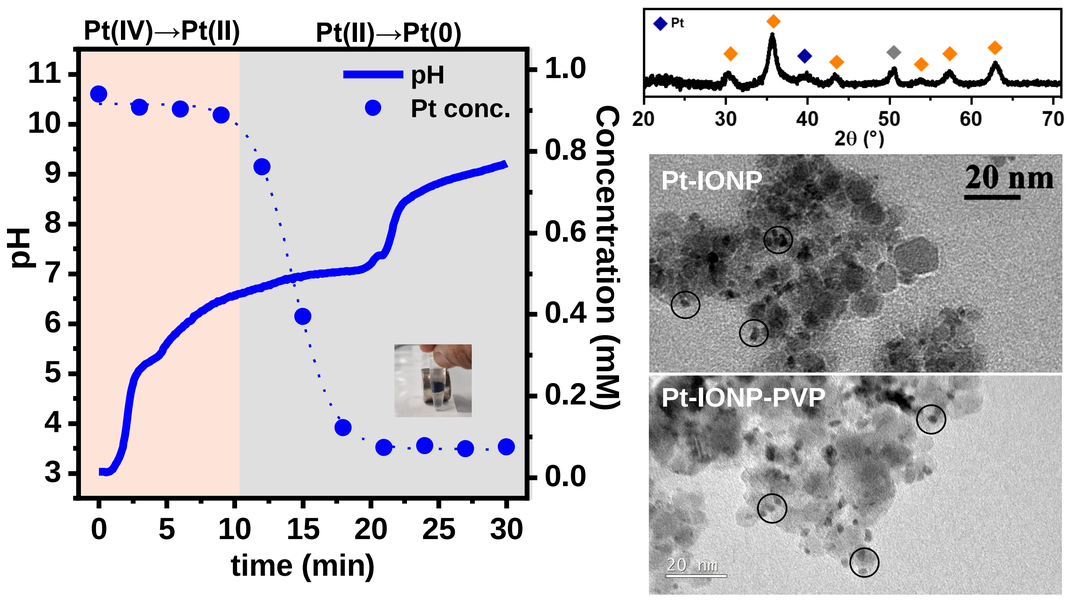
RESULTS

Synthesis and Characterization

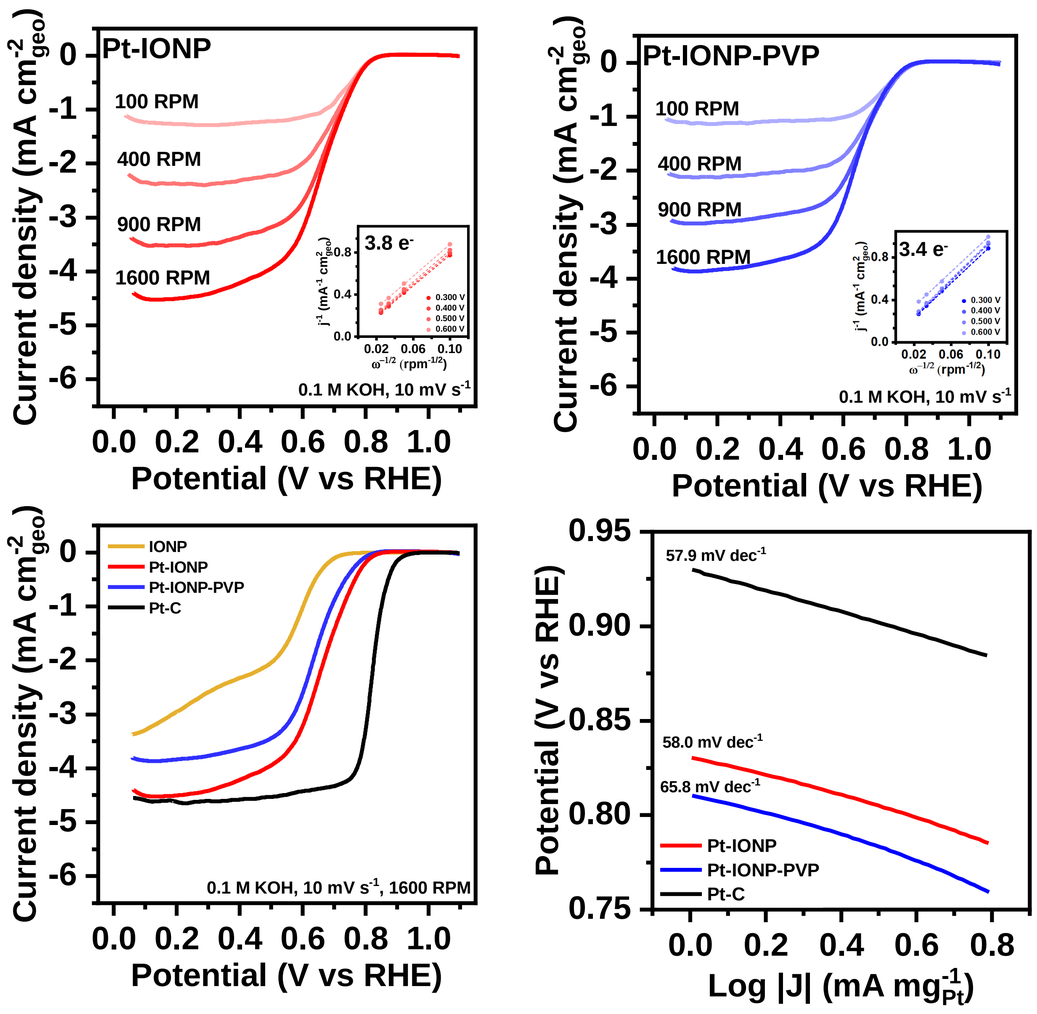
Part 1: Synthesis of IONPs supporter



Part 2: Synthesis of Pt-IONPs



ORR electrocatalysis



CONCLUSIONS

The GDEx process is an adaptable method for Pt-IONP synthesis. Adding a stabilizer (PVP) controls the size and shape of the FeOx support, although it hampers catalytic activity. Pt-IONPs produced through GDEx hold potential for ORR applications. To boost catalytic performance, we need to enhance their conductivity. GDEx is not limited to Pt-Fe oxides—it is a gateway to crafting noble metal and metal oxide nanoparticles like CeO_2, Mn_3O_4, Co_3O_4, and noble metals like Pd, Rh, and Au for different catalytic applications.

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