# *High Performance One Dimensional Nanocable Catalysts for Fuel Cells*

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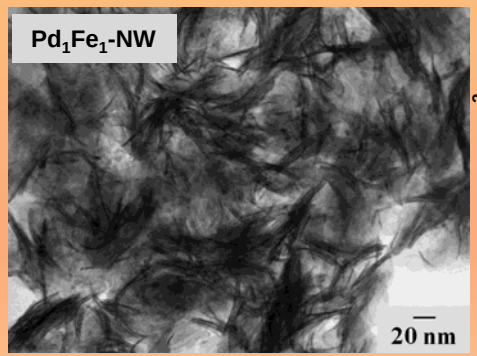
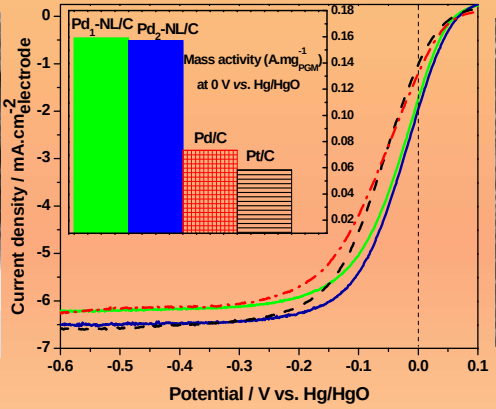
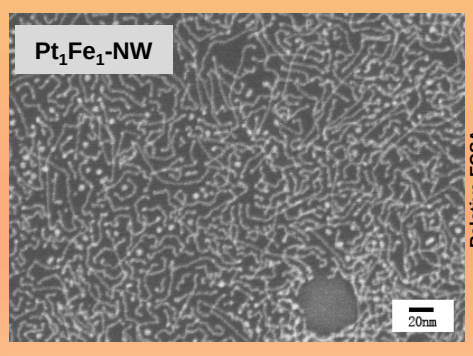
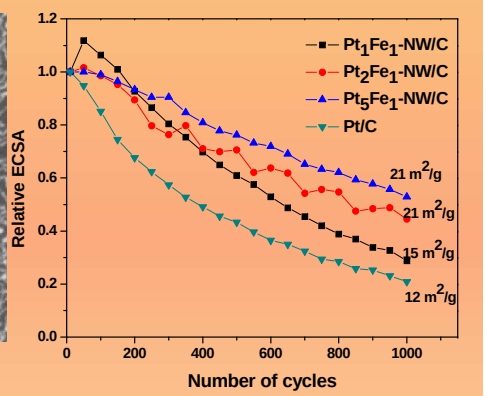
The objective of this ACS-PRF project is to study high performance one dimensional (1-D) M (Fe, Co, Ni) core Pt Shell nanocable catalysts for fuel cells. The nanocable catalysts will have ***improved activity*** due to their tuned electronic property (optimized d-band center) and more advantageous Pt(111) facets; ***enhanced durability*** (because it can avoid nanoparticle agglomeration); and ***reduced cost*** (because only a thin layer of Pt on the catalyst surface). Success of this research will acquire fundamental understanding of controlled wet-chemistry synthesis of multi-metallic nanocatalysts at the nano and atomic scale, and deep the insights into the structure-catalytic function relationships. This research will open a new avenue for design and preparation of efficient catalytic materials, and help our efforts to diversify the current energy supply status and reduce our dependence on foreign petroleum.

We have developed a precise solution-phase synthesis method to preparation of 1-D metallic nanostructures, including PdFe-nanoleaves (nanowires), PtFe-nanowires catalysts. Their detailed structures have been characterized by XRD, TEM, HAADF, S-TEM, EDS, XPS, etc. and these 1-D nanocatalysts have demonstrated higher electrochemical performances than commercial Pt/C catalyst.




*** $Pd_1$-NL, $Pd_2$-NL: $Pd_1Fe_1$-NW, $Pd_2Fe_1$-NW after acetic acid treatment.**

The PdFe-nanoleaves with a Pd-rich nanowire (diameter: 2 nm, tunable length: 30-100 nm) vein and Fe-rich sheets blade were prepared through the solution-phase method, and demonstrated 2.7 times greater oxygen reduction reaction mass activity than Pt/C in alkaline electrolyte. (Zhiyong Zhang, Karren More, Kai Sun, Zili Wu, Wenzhen Li, Chemistry of Materials, 2011, 23, 1570.)

Ultra-thin $Pt_xFe_y$-nanowires ($Pt_xFe_y$-NWs, ratio of Pt to Fe is x,y ) with a diameter of 2–3 nm were prepared through the solution-phase method. After 1000 cycles of 0–1.3 V (vs RHE), the relative electrochemical surface area (ECSA) of $Pt_2Fe_1$-NW/C dropped down to 46%, of its original value, which was two times better than Pt/C (20%). (Zhiyong Zhang, Meijun Li, Zili Wu, Wenzhen Li, Nanotechnology, 2011, 01562)

In our future research, we will study the mechanisms of 1-D metallic nanostructure formation, investigate *in-situ* electrochemical probe reaction to monitor structural change of 1-D nanocatalysts, and extend this synthesis method to prepare nanostructured non-Pt catalysts, such as 1-D Ag nanostructures, for fuel cell applications.