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Improving the Performance of Fuel Cells using Pt-Based Nano-Crystalline Catalysts

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Improving the Performance of Fuel Cells Using Pt Based Nano-crystalline Catalysts

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Background

- Reducing global carbon footprint requires green energy conversion devices
- Fuel cells produce electricity through oxygen reduction reaction (ORR) at the electrodes

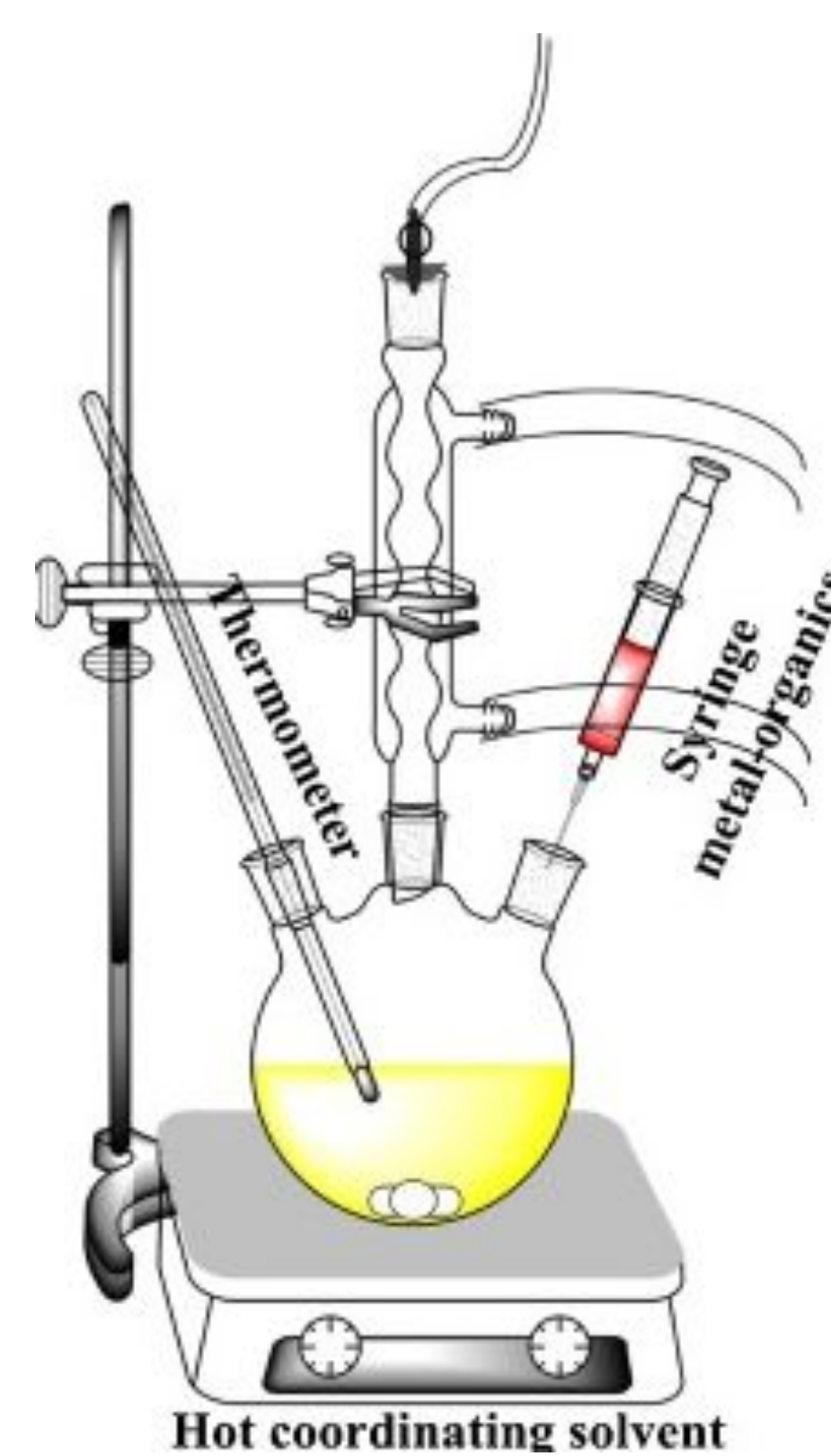


Materials Requirement

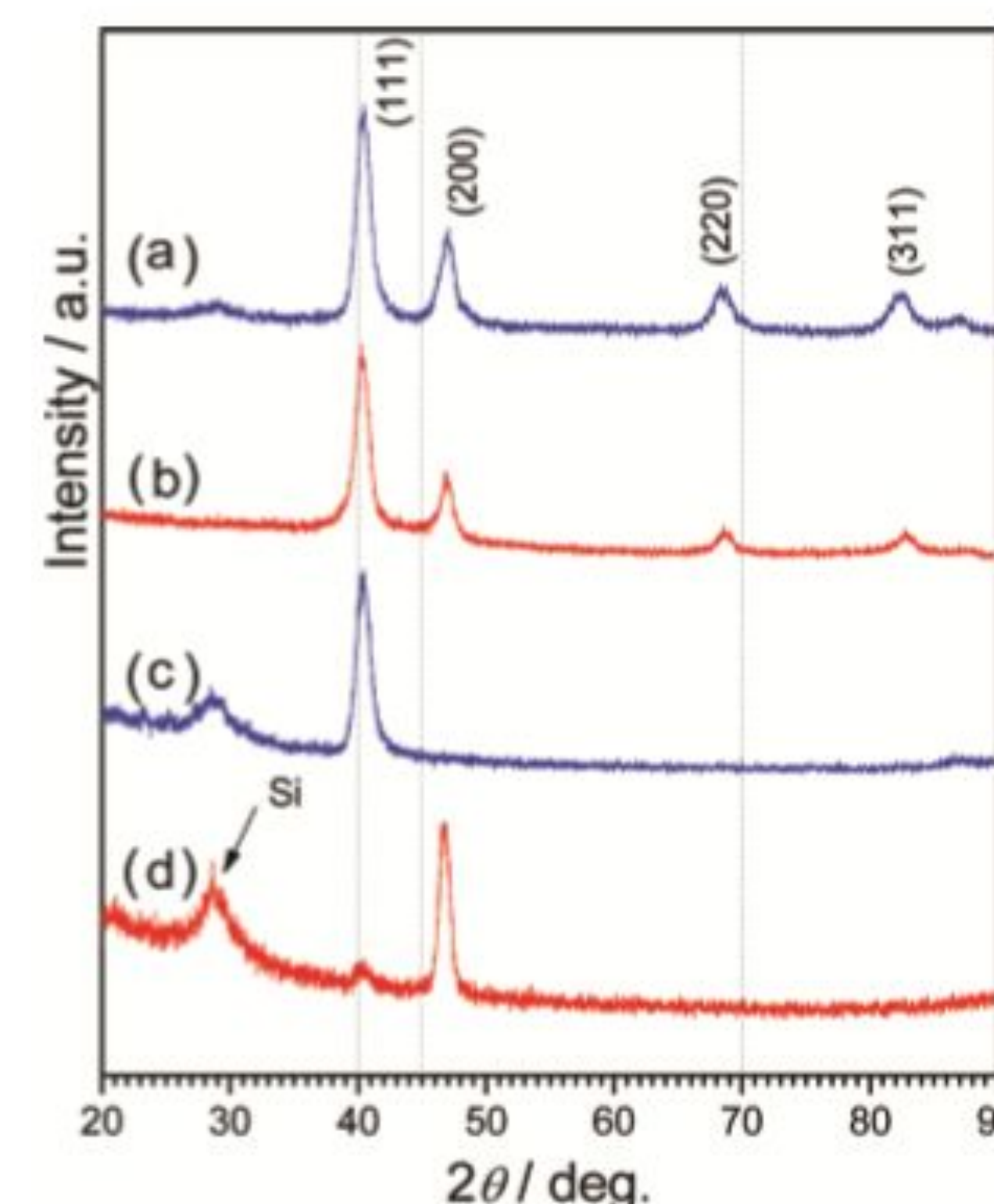
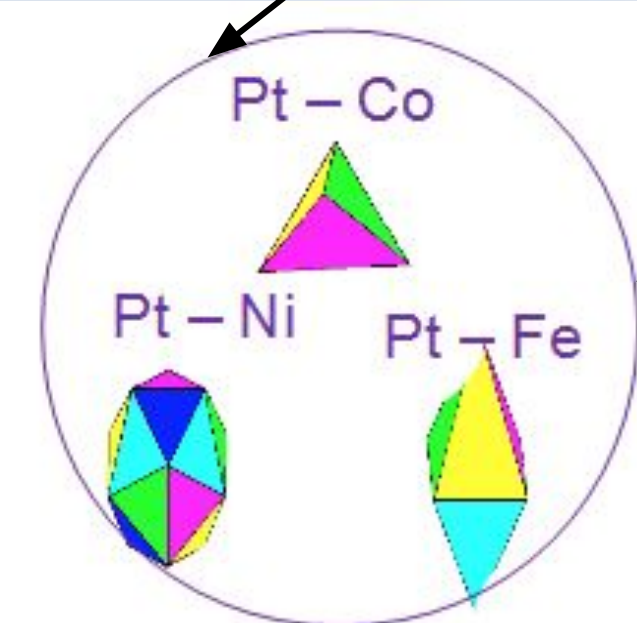
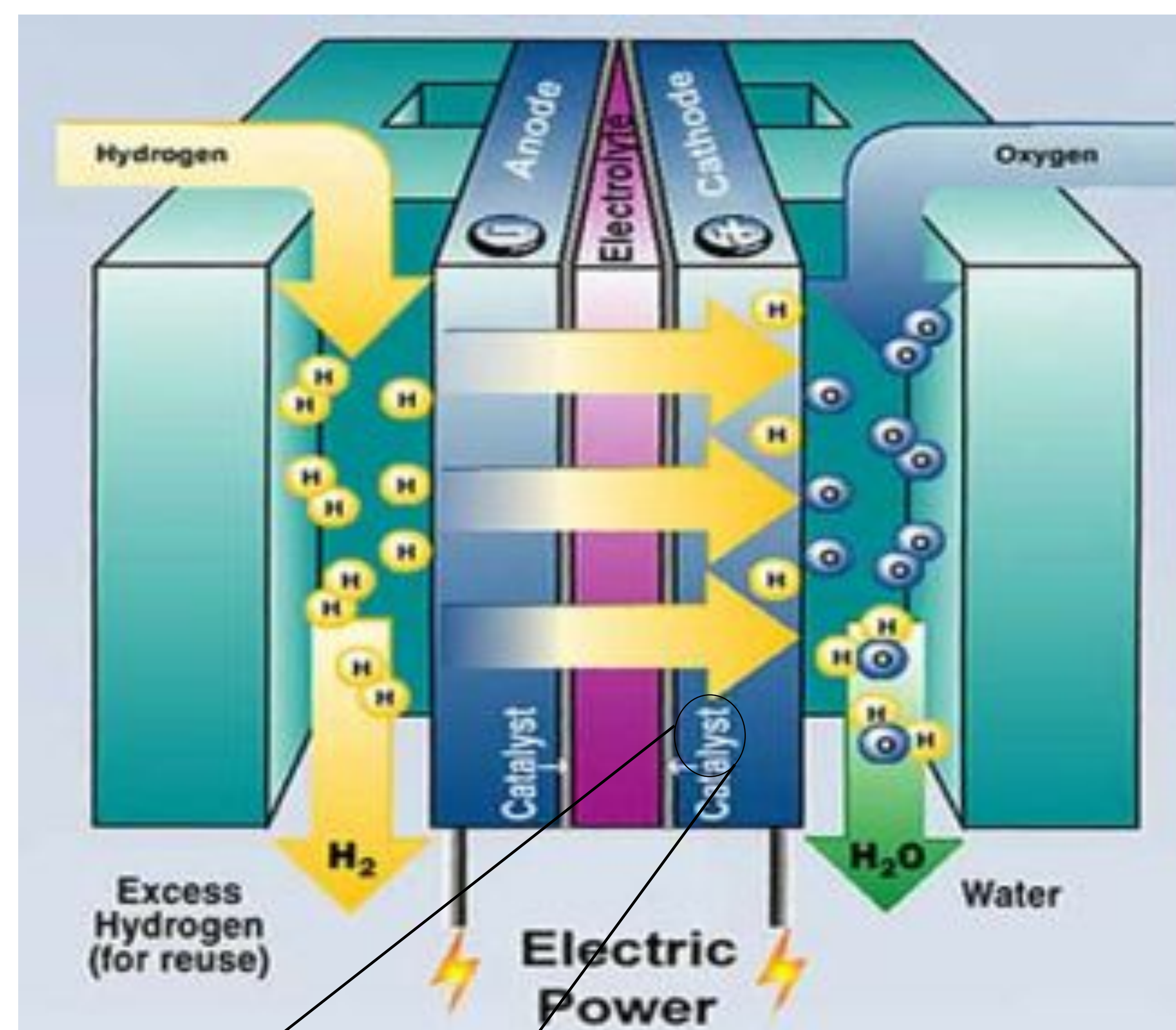
- High activity
- Large surface Area
- Chemical stability

Synthesis

- Pt based nano-crystalline catalysts
- 3d transition metal alloying
- “One-pot” synthesis strategy

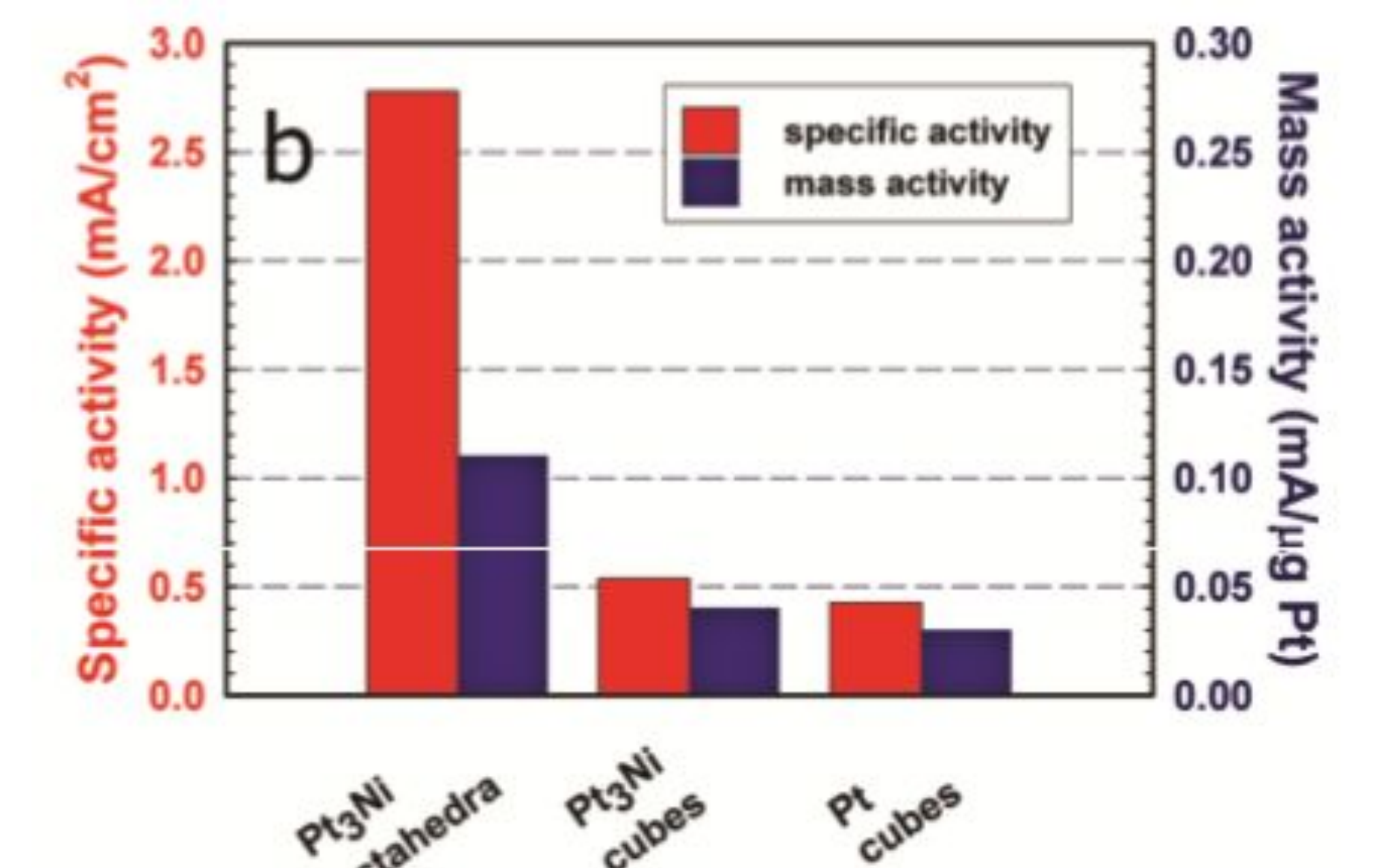


Nano-crystalline Catalysts Characterization



XRD pattern of Pt₃Ni NCs. (a, c) Nanooctahedra. (b, d) Nanocubes. (a, b) Samples were randomly deposited on a zero-background sample Holder. (c, d) Samples were assembled on a polished Si wafer.

Results



- Nanooctahedra ~ 10.6 nm, nanocube ~ 10.3 nm crystal sizes
- Increased specific activity to 3 mA/cm² using 9 nm crystal size

Conclusions

- Successful synthesis of nanooctahedral crystals using one-pot method
- Reducing crystal size led to increased activity

Future work

- Further reduction of crystal size, less than 9 nm
- Synthesize nano-tetrahedral crystals
- Determine material alternatives to Pt, reduce use of precious metals in the catalyst.

References

- Jun Zhang, Hongzhou Yang, Jiye Fang and Shouzhong Zou, Synthesis and Oxygen Reduction Activity of Shape-Controlled Pt₃Ni Nanopolyhedra, *Nano Lett.* 2010, 10, 638-644.
- Sang-Il Choi et. al, Synthesis and Characterization of 9 nm Pt–Ni Octahedra with a Record High Activity of 3.3 A/mgPt for the Oxygen Reduction Reaction, *Nano Lett.* 2013, 13, 3420–3425