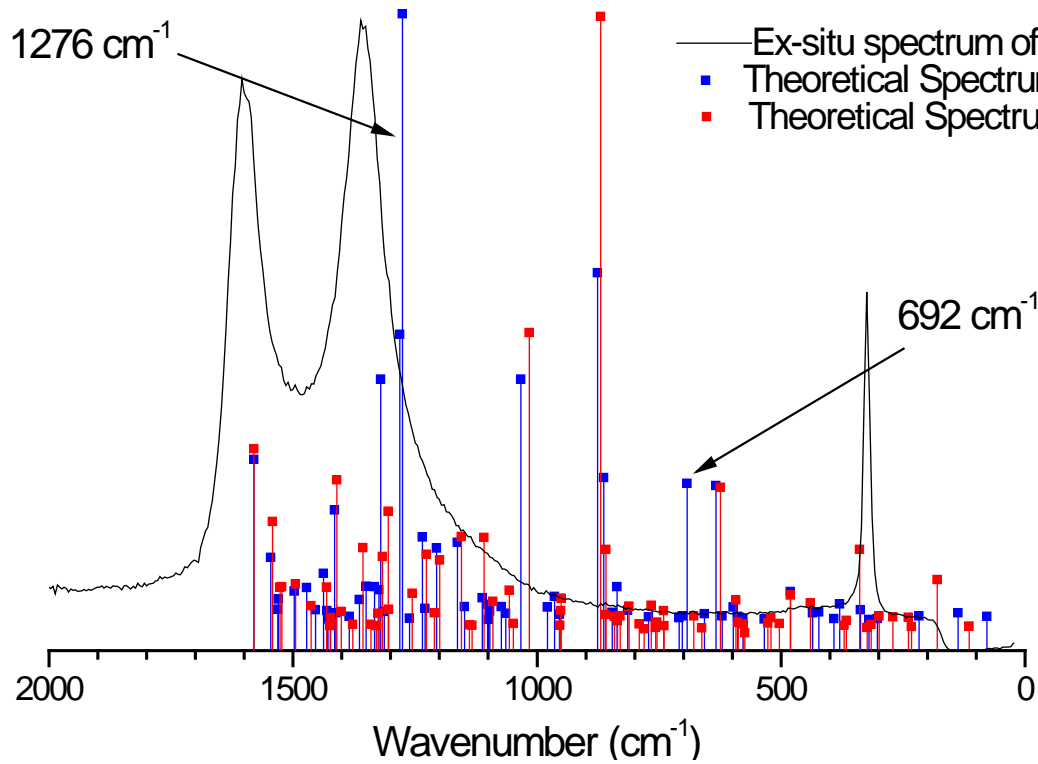


Operando Raman and Theoretical Vibration Spectroscopy of Non-PGM Catalysts

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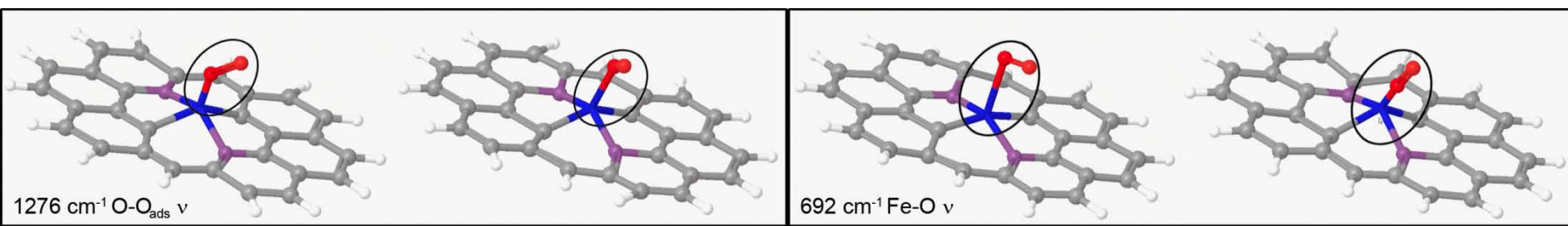
Presented at the CWG DOE





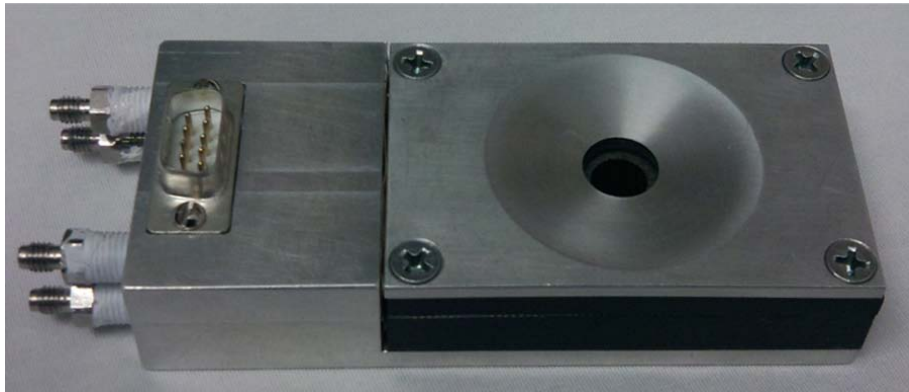
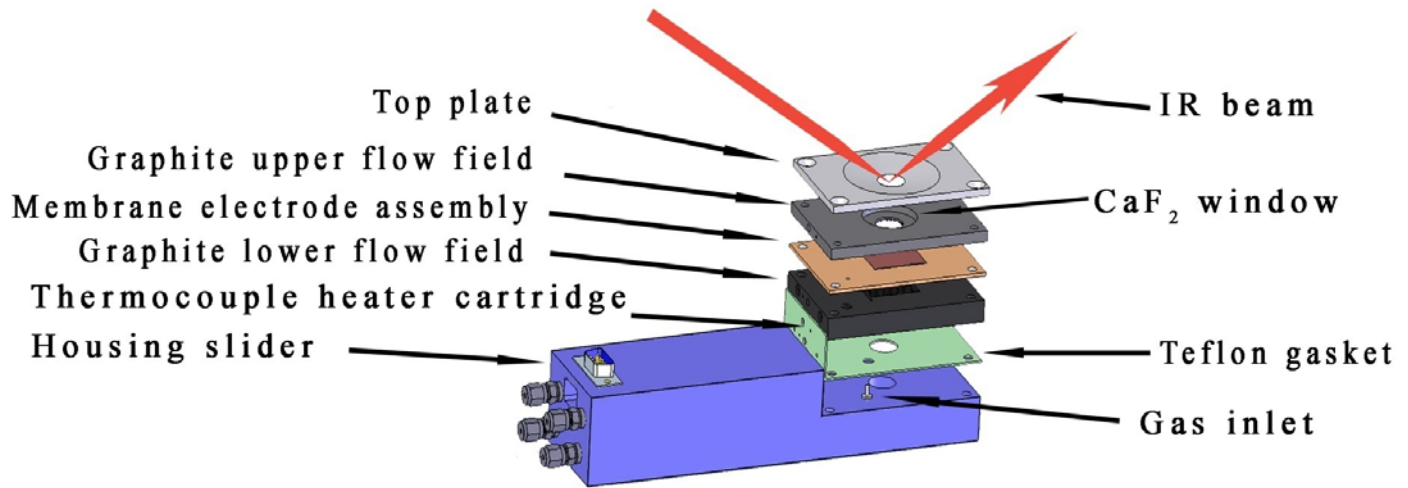
— Ex-situ spectrum of non-PGM catalyst
 ■ Theoretical Spectrum of non-PGM catalyst with O₂
 ■ Theoretical Spectrum of non-PGM catalyst with no O₂

- Components
 - Carbon (Ketjen Black 600)
 - Iron (iron acetate, 0.75% wt Fe)
 - Nitrogen (melamine, 6.3 % wt N)
- Pyrolyzed at 800 °C
- Fe content is 0.318% (by ICP)

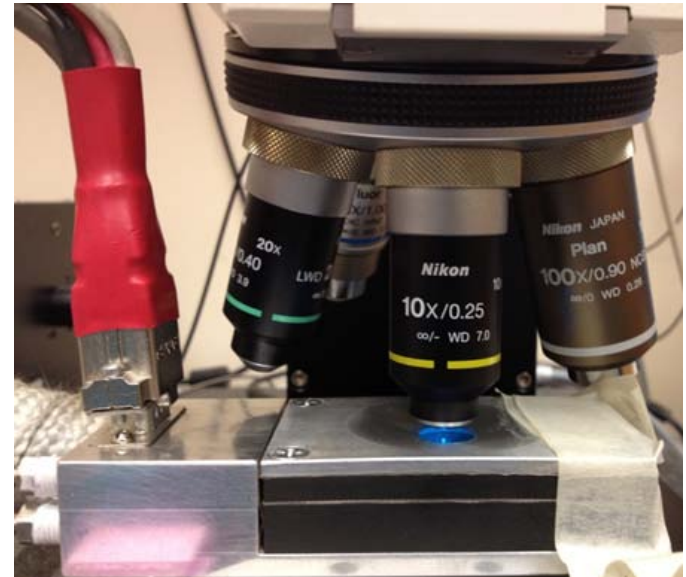


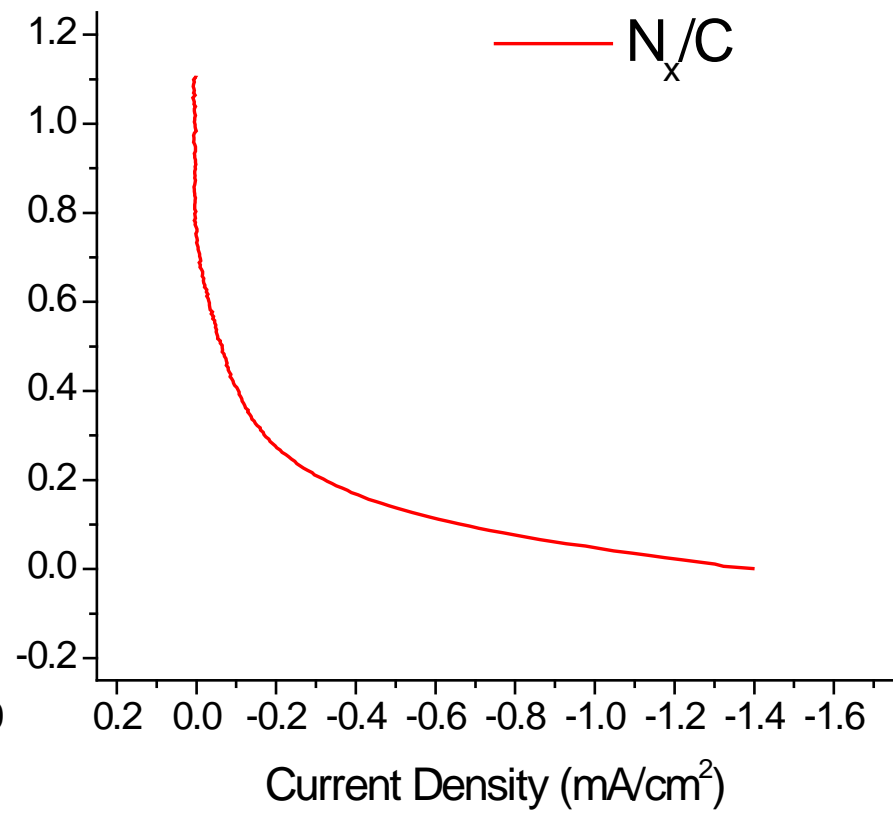
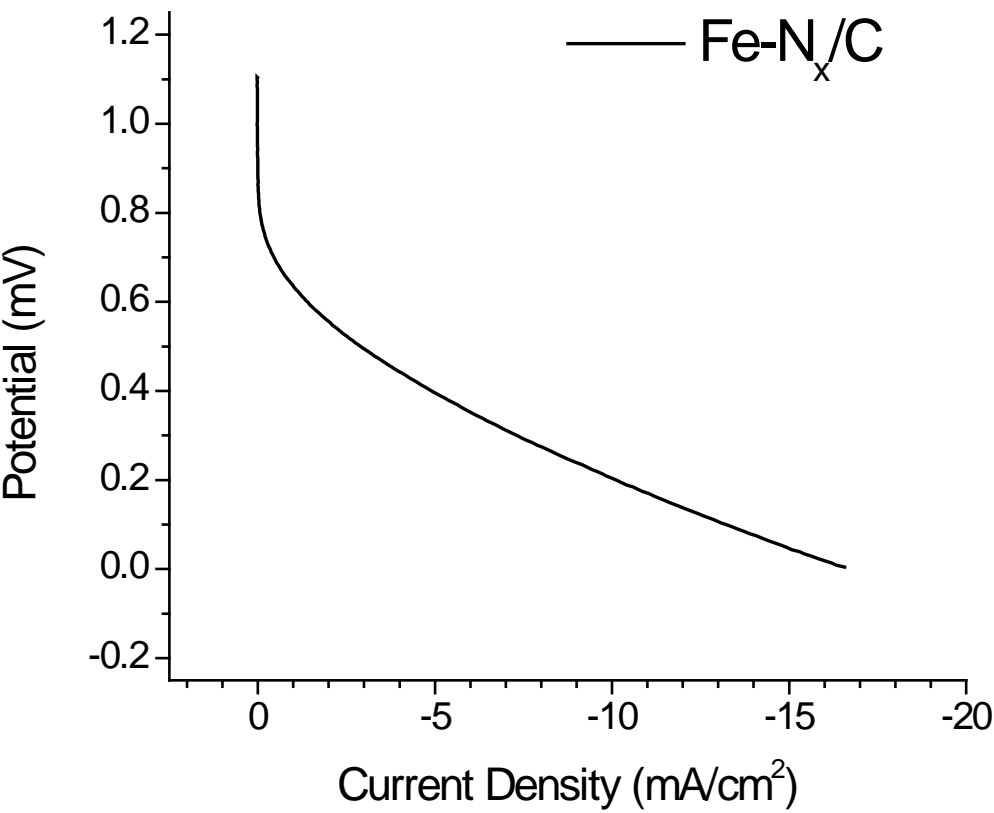
Nallathambi, V. *Electrochem. Solid State Lett.* **2011, 14, B55.**





- Cell operating at 50 °C
- 200 sccm O₂
- 10x objective
- 488 nm laser
- 23 mW
- CCD Detector

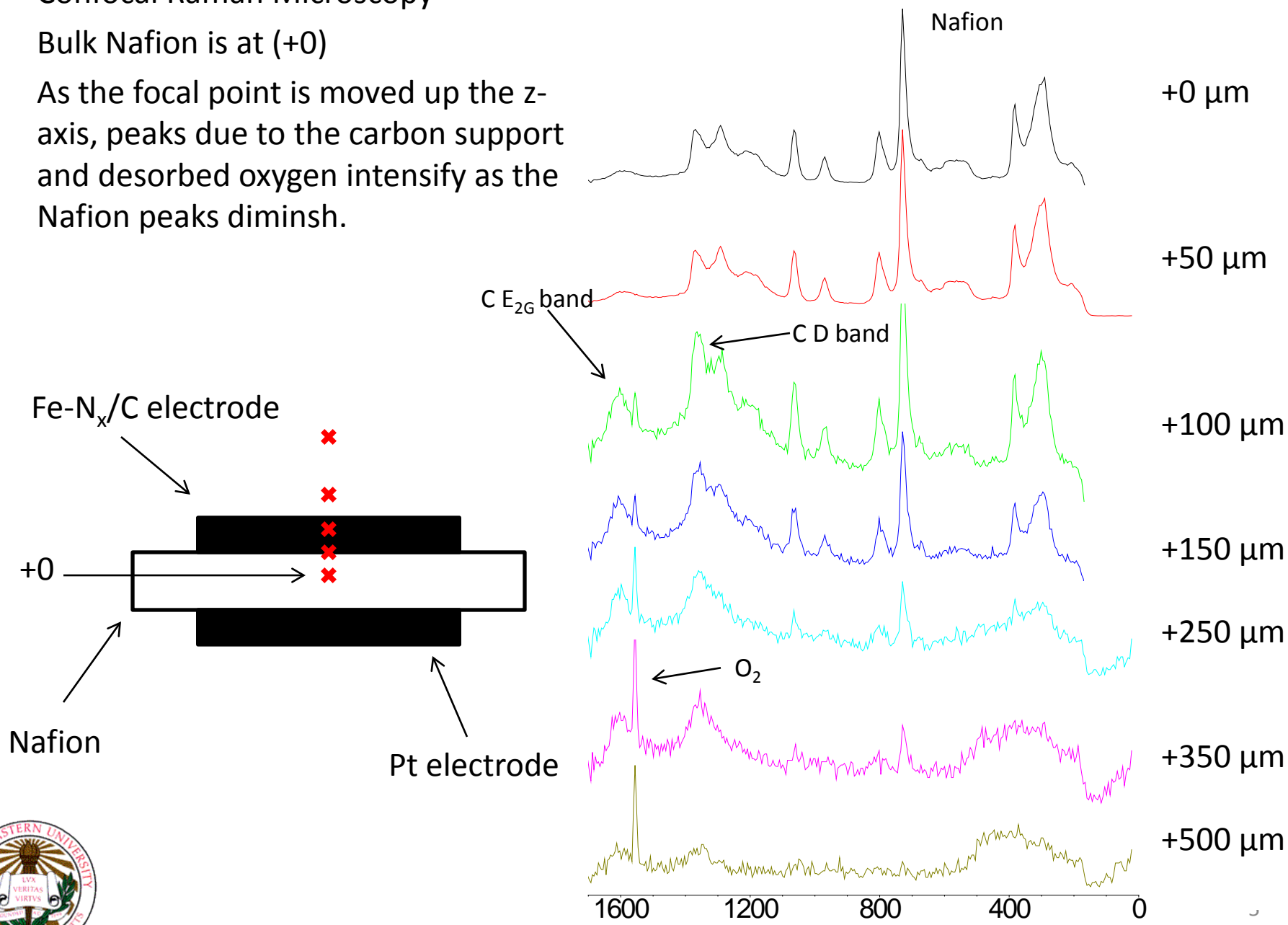


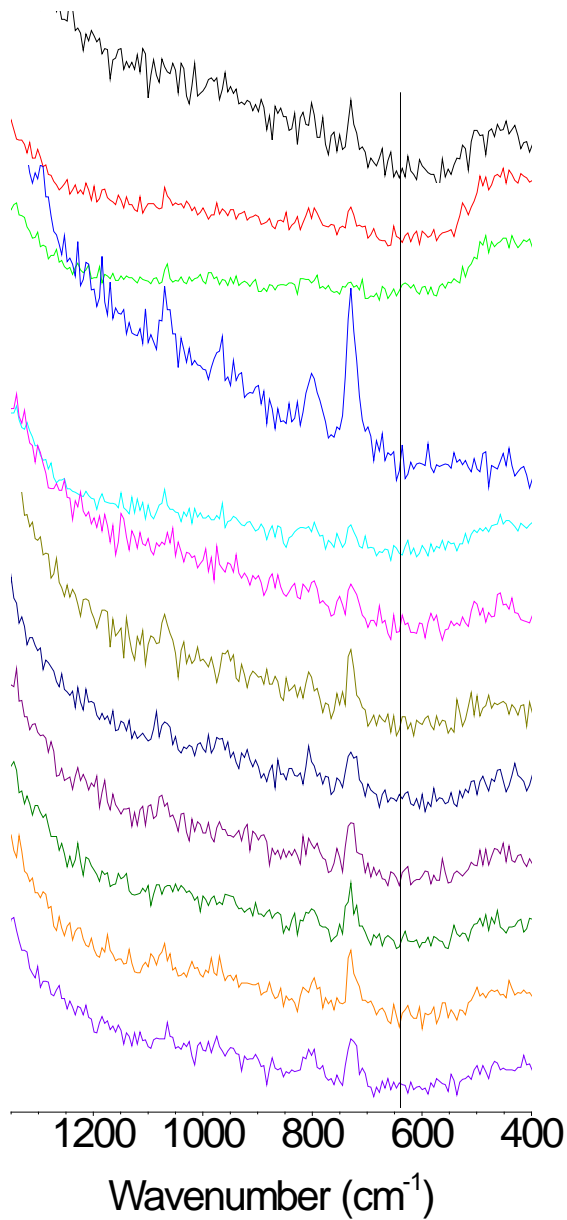


About a factor of 20 improvement with the addition of Fe.

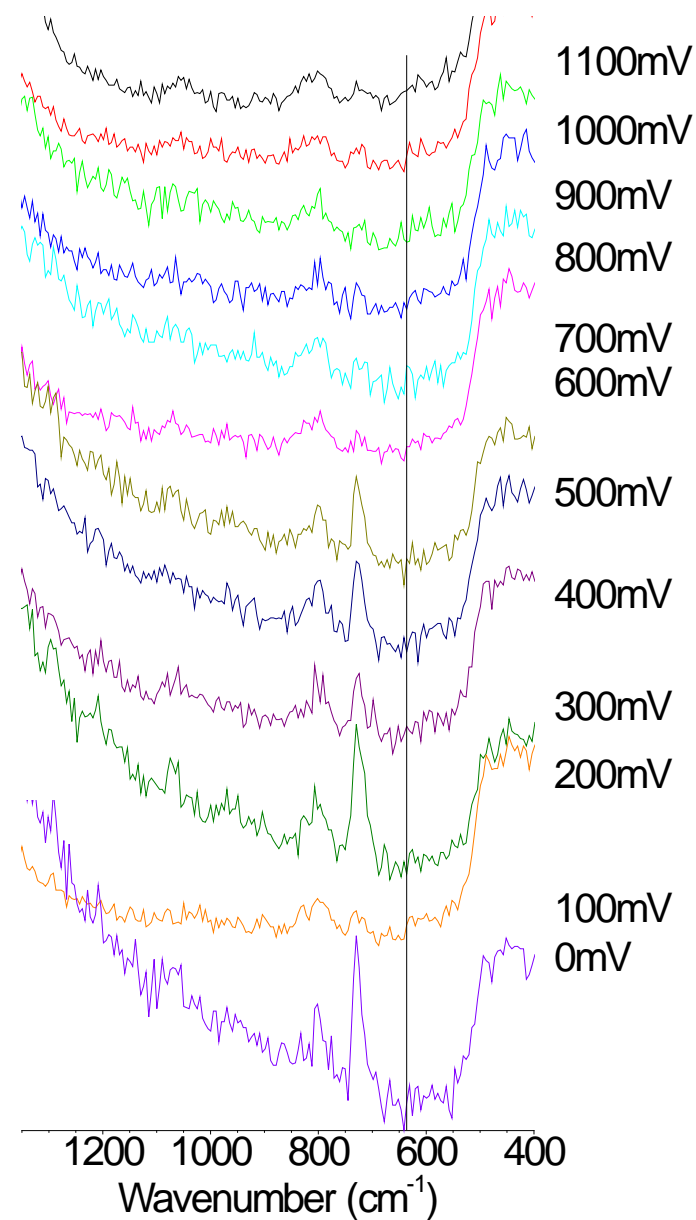


- Confocal Raman Microscopy
- Bulk Nafion is at (+0)
- As the focal point is moved up the z-axis, peaks due to the carbon support and desorbed oxygen intensify as the Nafion peaks diminish.





N_x/C Spectra acquired in oxygen

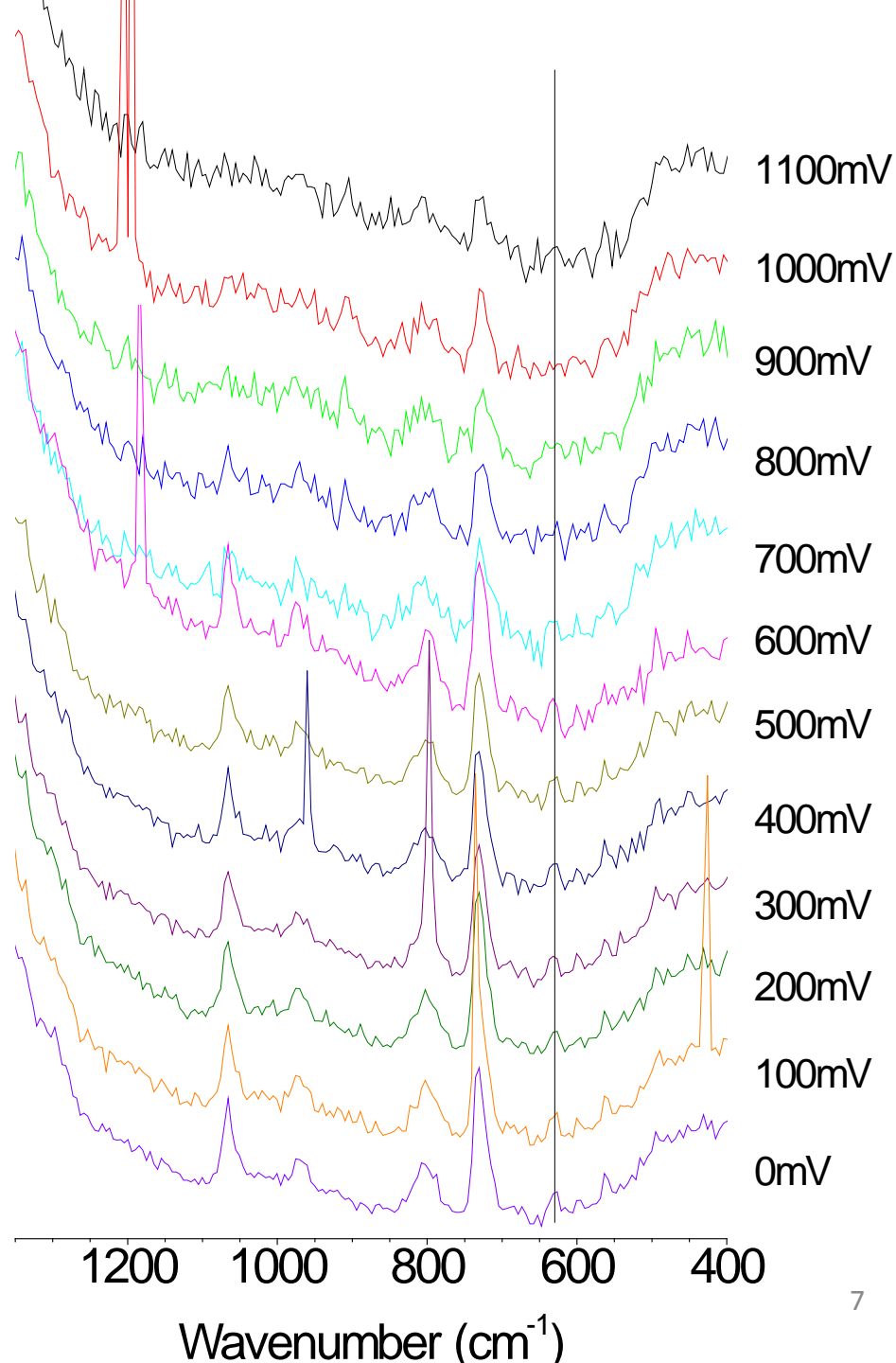


$Fe-N_x/C$ Spectra acquired in nitrogen

The peak at 636 cm^{-1} is not observed in either control



- Fe-N_x/C catalyst
- Focal point at +350 μm
- At 700 mV, 636 cm⁻¹ appears.



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- Ian Kendrick, Fuel cell
- S. Mukerjee DOE program

