

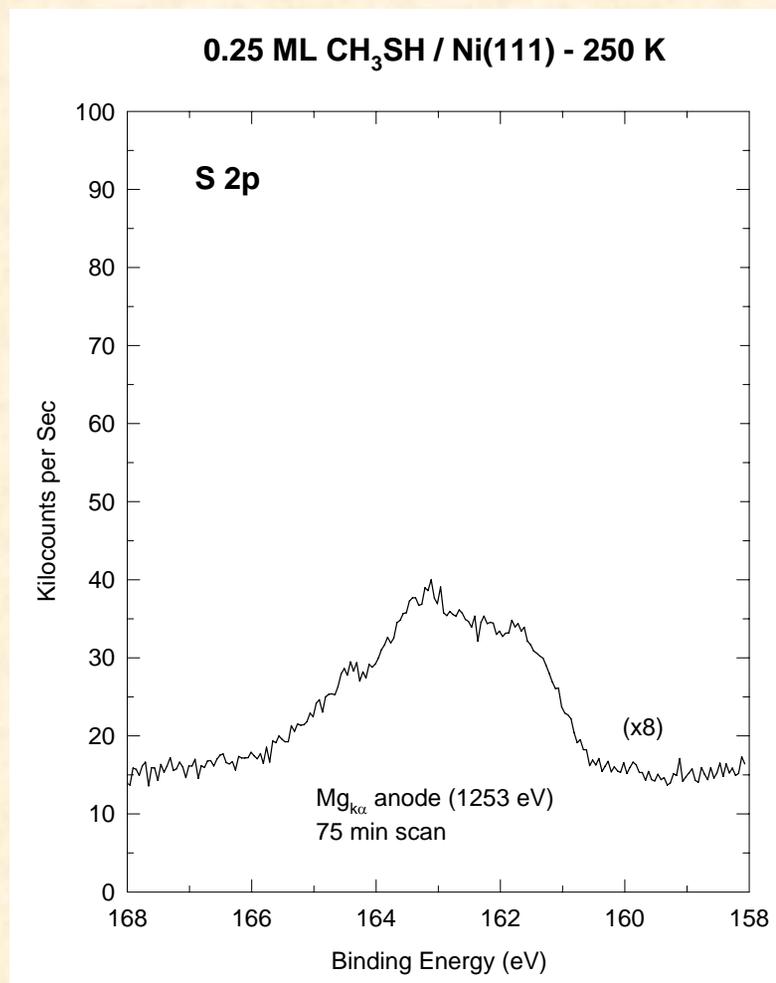
Surface Chemistry and Catalysis with Soft X-rays



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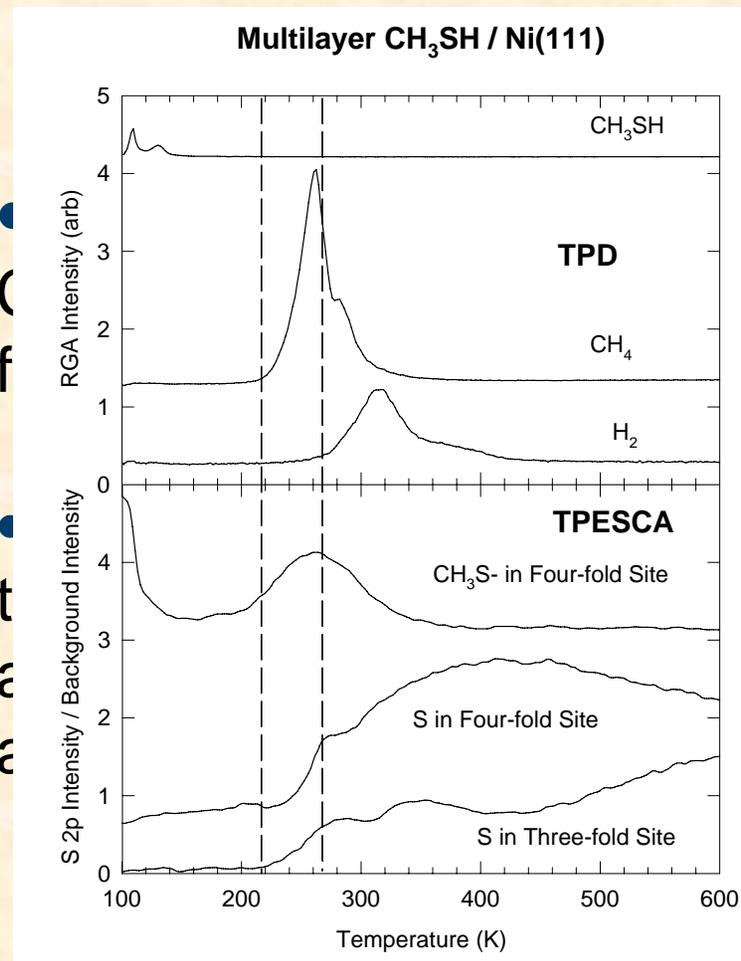
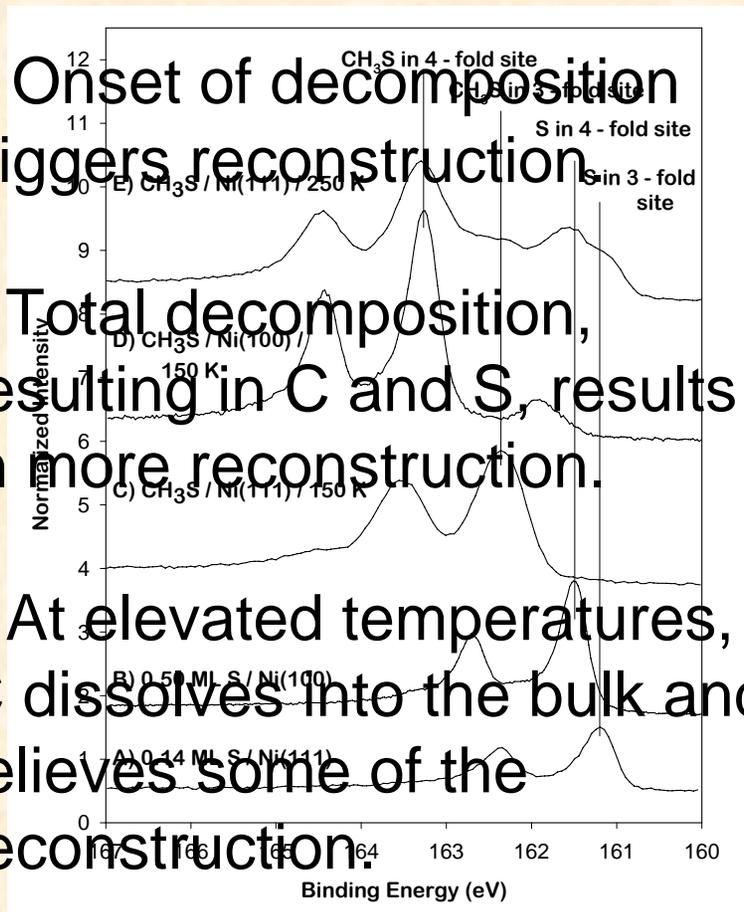
Why Use a Synchrotron for XPS?

- XPS is a powerful technique in chemical research
- At the synchrotron we can do it:
 - BETTER
 - FASTER
 - CHEAPER (!?)

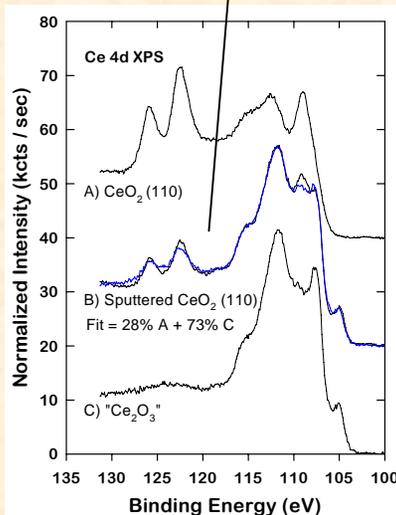
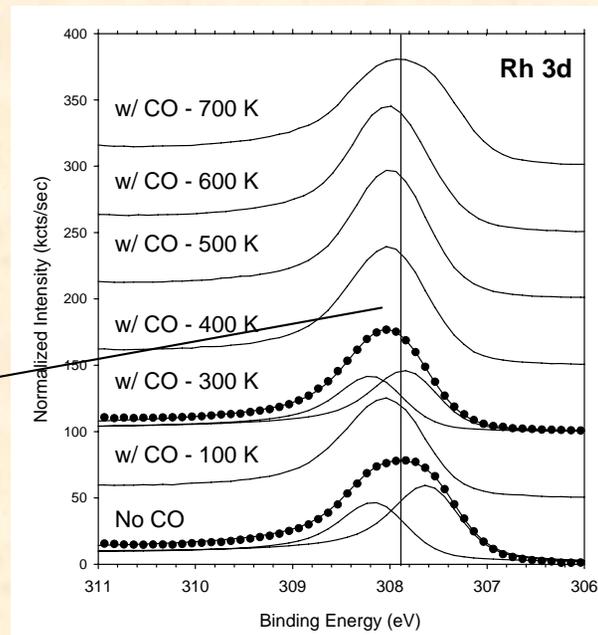
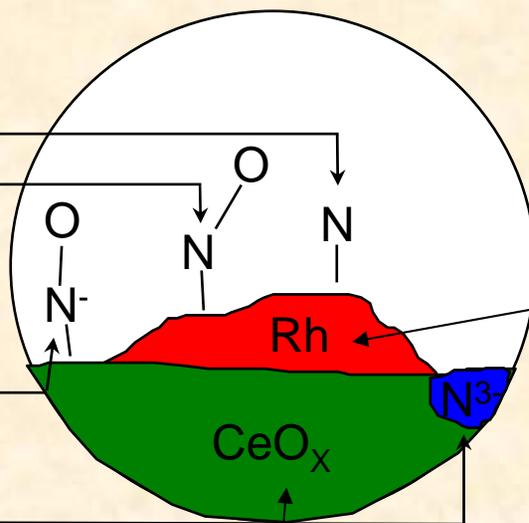
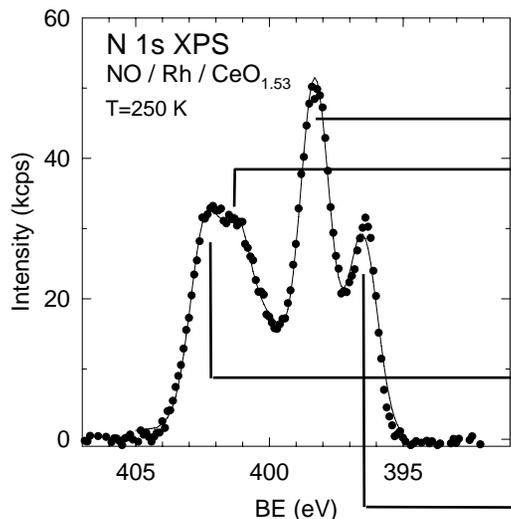


What Can We Do With the Extra Sensitivity?

- Onset of decomposition triggers reconstruction.
- Total decomposition, resulting in C and S, results in more reconstruction.
- At elevated temperatures, C dissolves into the bulk and relieves some of the reconstruction.

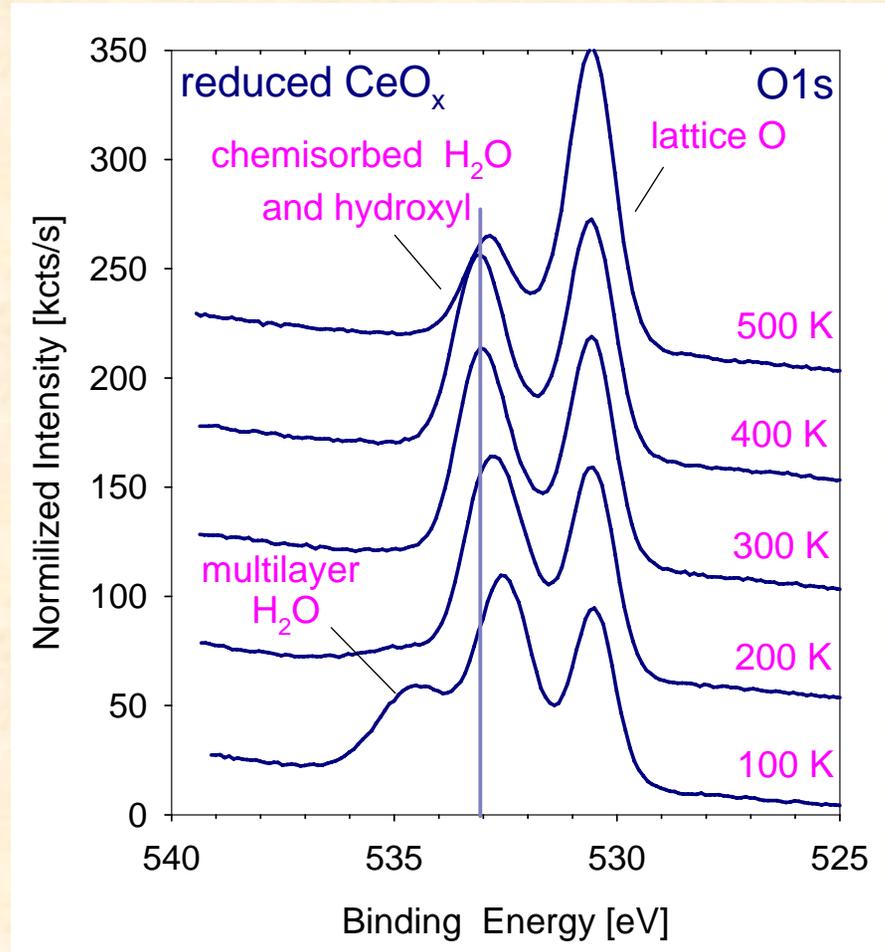


Study a Complicated, Multicomponent System

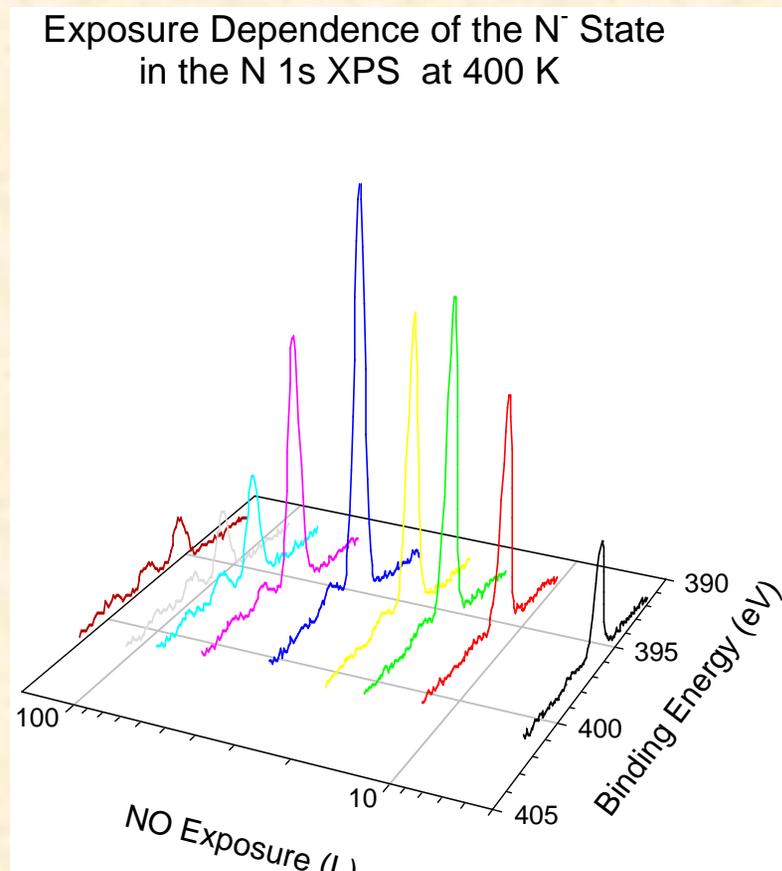


Surface Sensitivity

- The photoelectron's escape length depends on the electron kinetic energy.
- The escape length is a minimum near 50 eV.
- The electron kinetic energy can be “tuned” by adjusting the excitation energy.

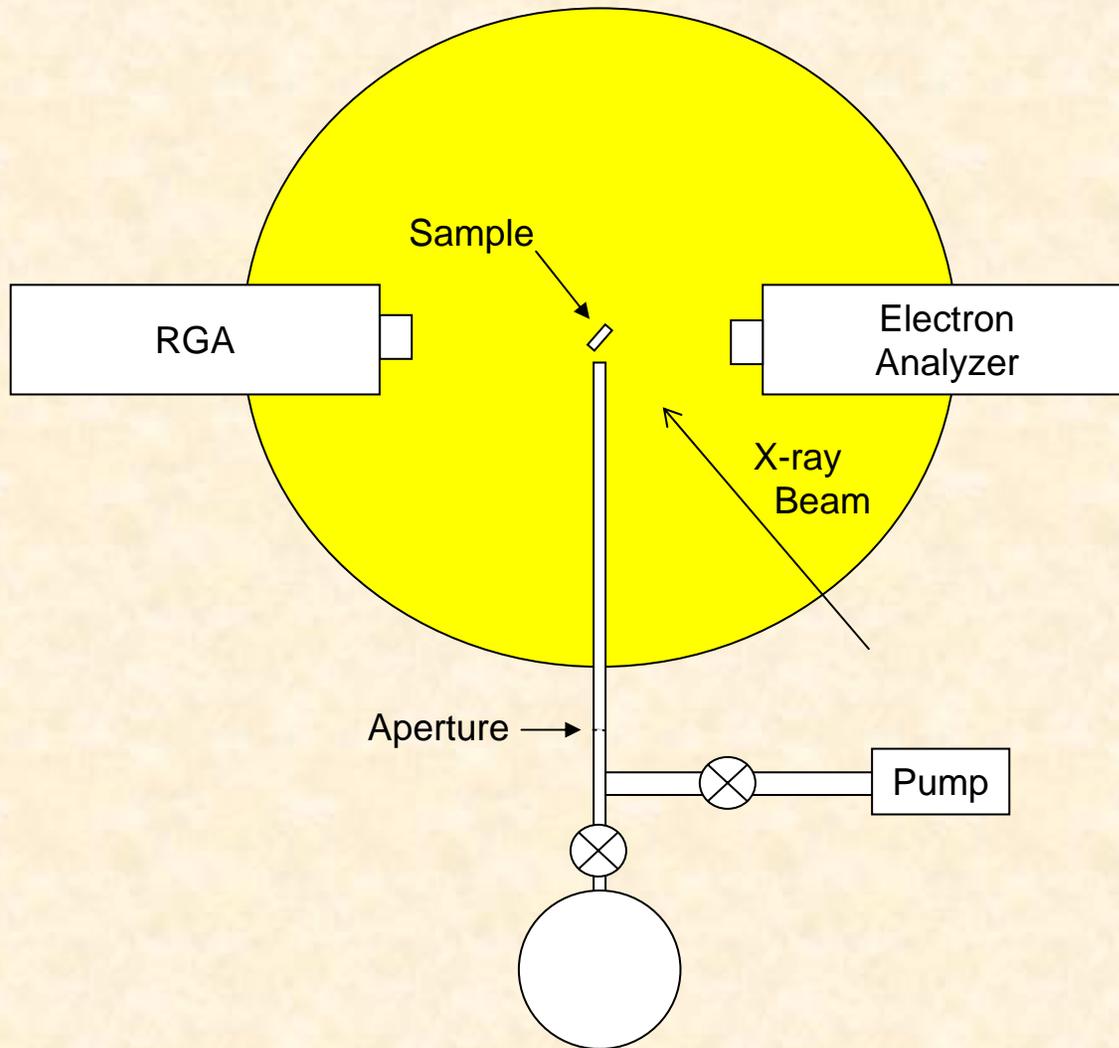


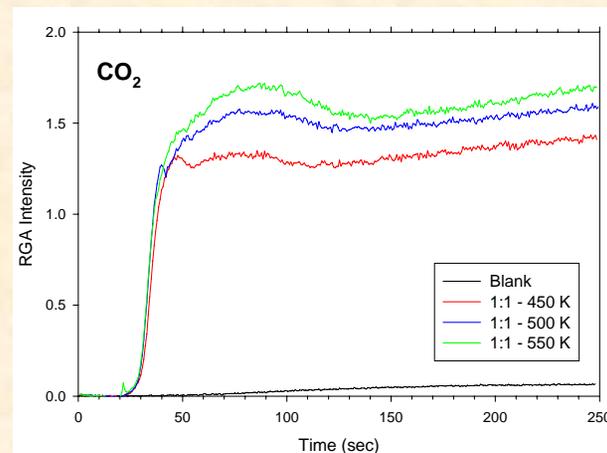
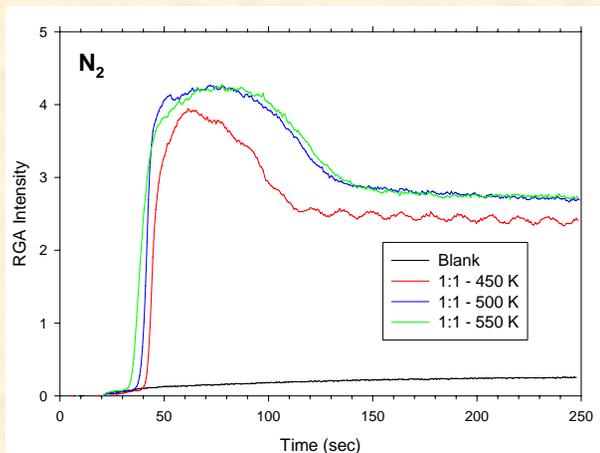
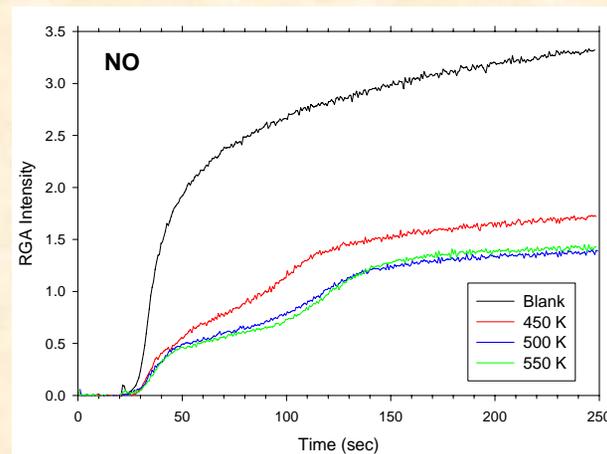
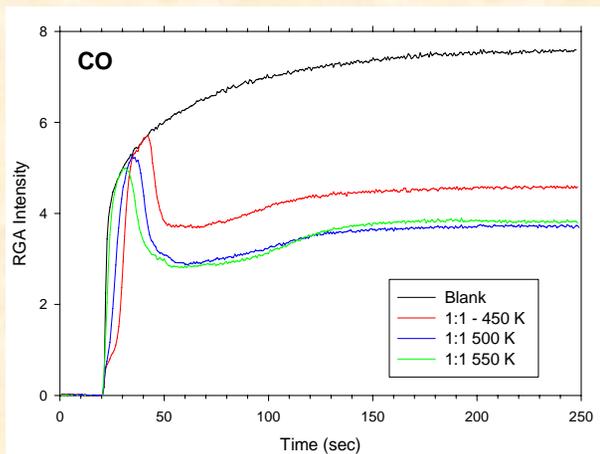
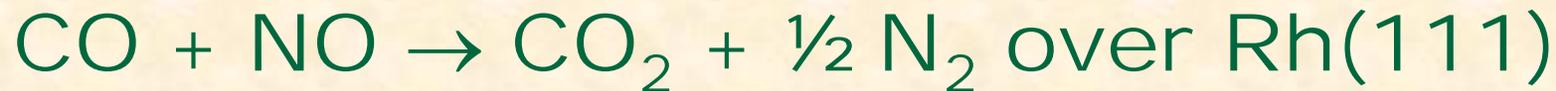
Something a little more “dynamic”



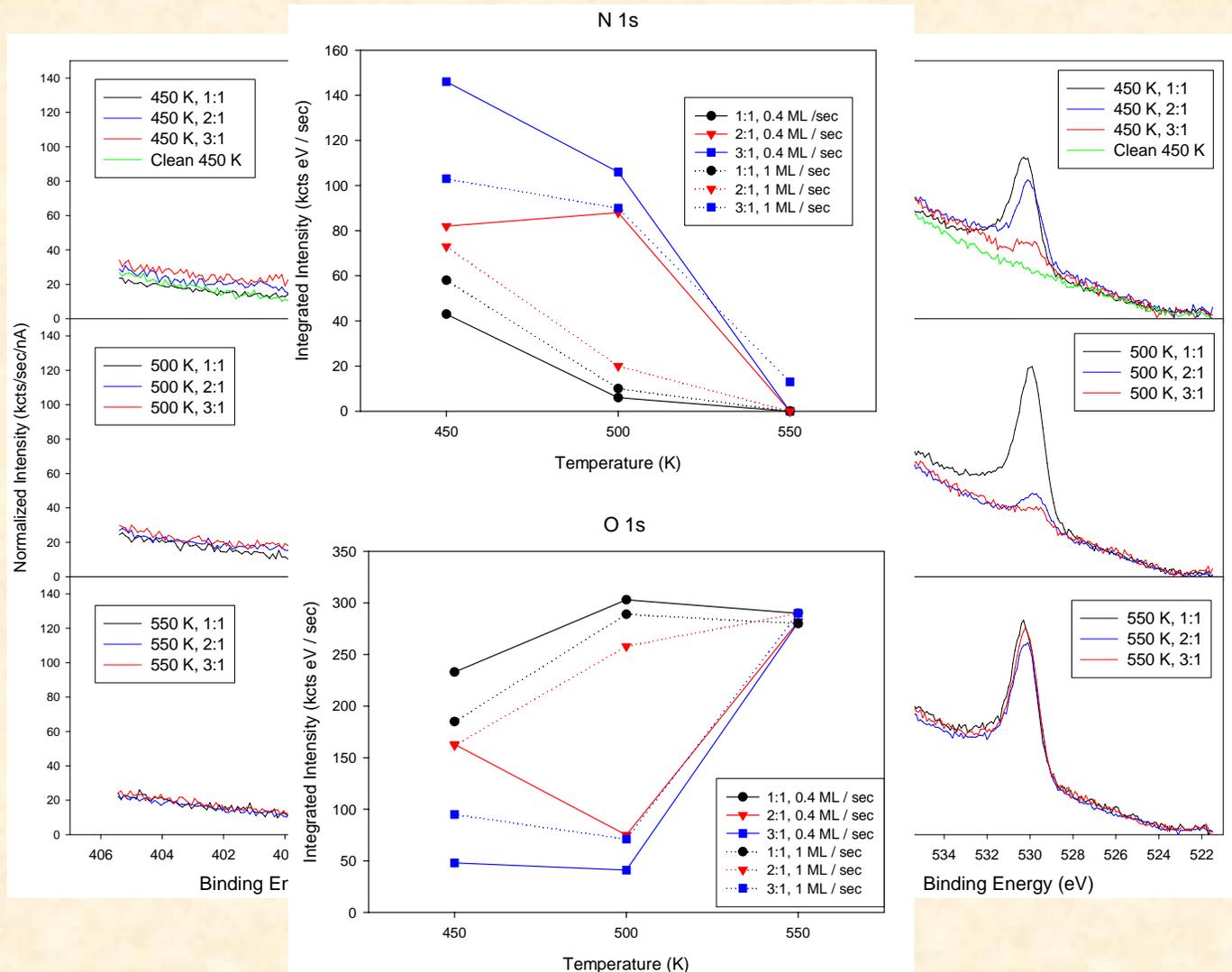
Model: NO dissociates at 400 K forming N⁻ and O²⁻. As the exposure is increased the available adsorption sites are occupied, N⁻ is displaced by O²⁻ and desorbs as N₂.

What about something *operando*?

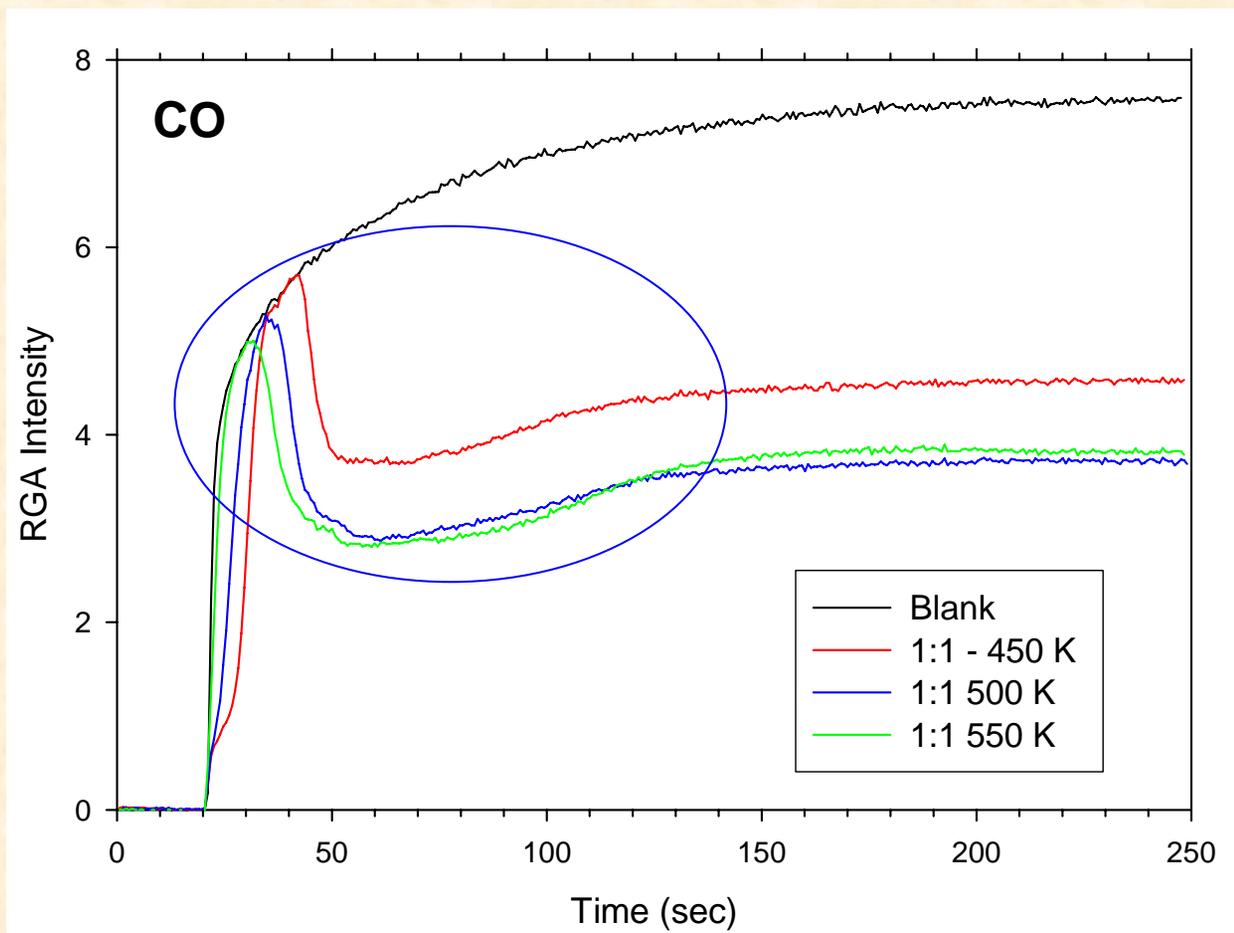




On the surface, only atomic N and O are seen

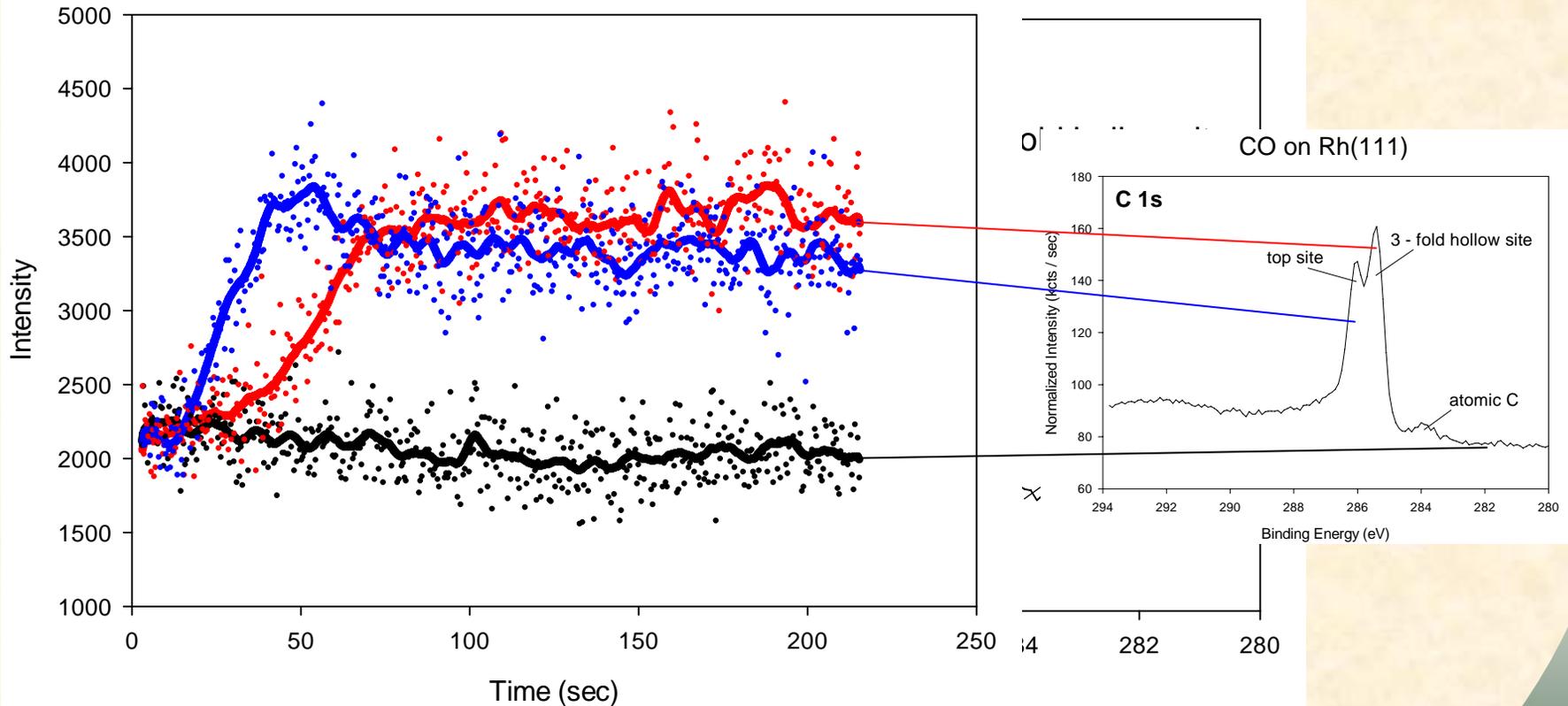


How about transients?

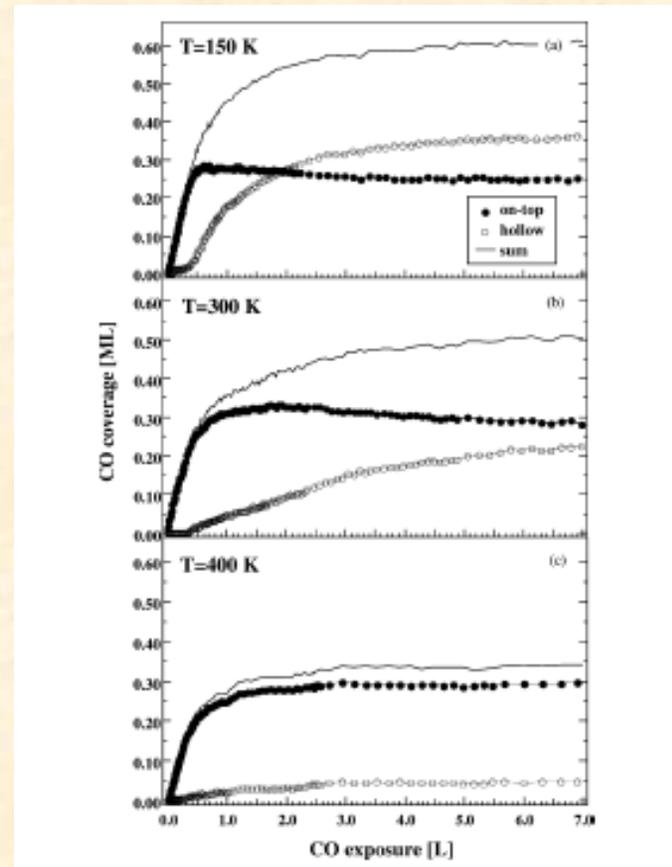
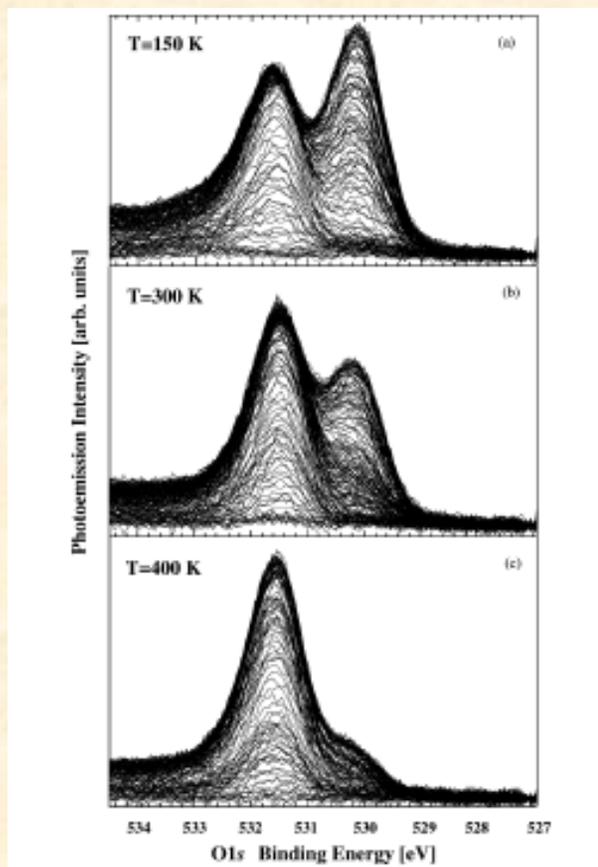


Proof of principle: CO on Rh(111)

CO on Rh(111) 120 K



It can be done better



A. Baraldi, G. Comelli, S. Lizzit, M. Kiskinova and G. Paolucci,
“Real-time X-ray photoelectron spectroscopy of surface reactions”,
Surface Science Reports 49 (2003) 169.

Summary

- **Sensitivity currently > 10^3 greater than a laboratory XPS system.**
- **Detection limits ~ 0.01 ML**
- **Analysis as a function of time, temperature and gas exposure have been demonstrated.**
- **Most, if not all, of the components in the system and be characterized.**