



# Contamination Monitoring BOC Edwards Activities

Anthony Keen

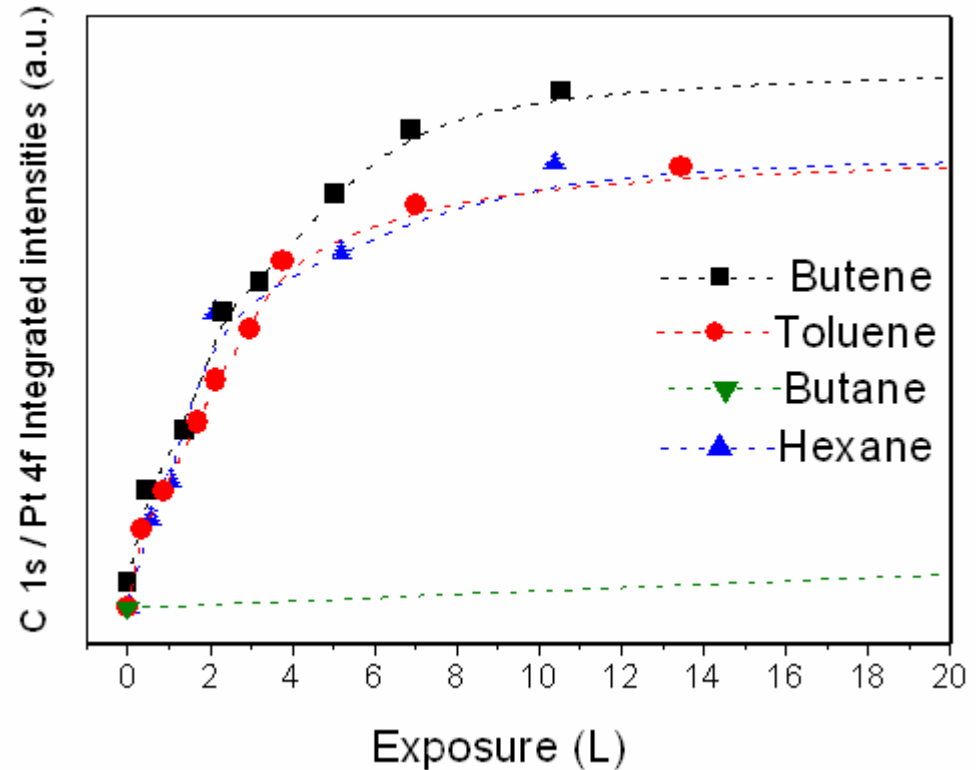
IEUVI Contamination and Optics Lifetime TWG  
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# What Do We Want To Measure?

- › Hydrocarbon levels need to be strictly controlled and monitored in the EUV tool environments.
  - RGA mass spectrometer is conventional tool employed to monitor contamination levels.
  - Two approaches to quantification of  $C_xH_y$  level
    - Measure  $\Sigma(45\dots200)\text{amu}$  or take average level of  $45\dots200\text{amu}$
- › Typical molecules likely to be present in EUV tool.
  - Alkanes, alkenes, alcohols, aromatics, acids, esters, pfcs...
- › Evidence to suggest not all molecules have same contaminating effect.
  - K. Boller et al, Nucl. Inst Meth. 208 (1983) 273
  - R. Kurt et al, Proc. SPIE 4688 (2002) 702-709
- › RGA has limitations, cross sensitivity to unharmed species, consequently BOCE is developing a hydrocarbon sensor for selective detection.
- › Making the assumption that a Pt surface at  $600^\circ\text{C}$  is a reasonable comparison to a Ru surface at room temp with EUV photons, BOCE with collaborator Univ. of Cambridge Chemistry Department has investigated adsorption of various hydrocarbon species.

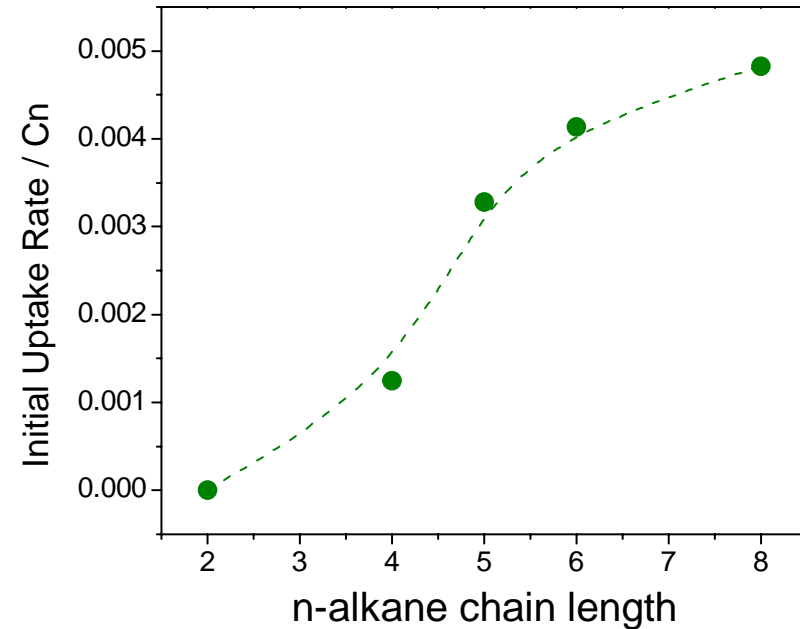
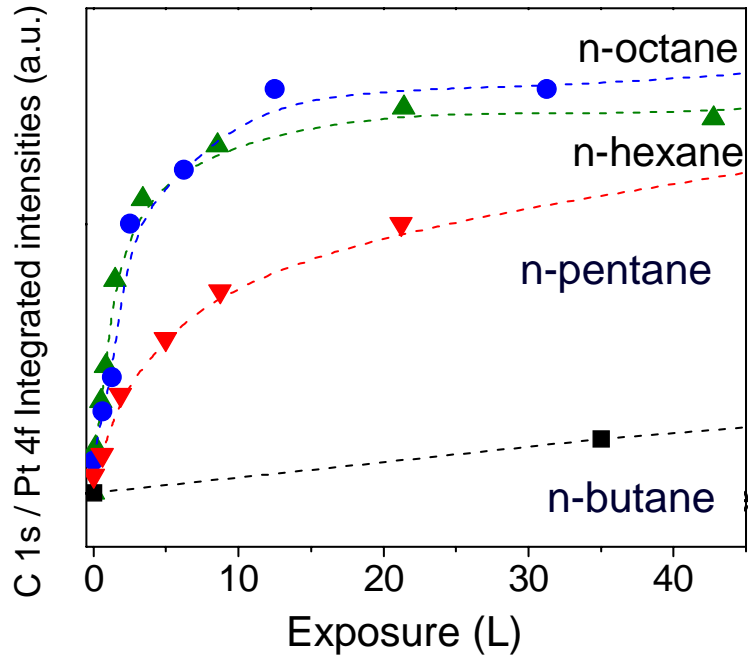
# Are All Hydrocarbons The Same?

- Investigation of adsorption of alkanes and alkenes on Pt surface at 600°C, performed by Prof. R.M.Lambert, Dr. G. Kyriakou and D.Davis Univ. Cambridge.
- The graph shows that unsaturates do stick on the Pt surface whereas low saturated alkanes do not stick.
- The cracking efficiency is observed to increase in line with the degree of unsaturation of the hydrocarbon.
- The Pt surface is able to distinguish between certain saturated and unsaturated hydrocarbon species.



Dissociative adsorption of alkenes and alkanes on Pt at 600°C.

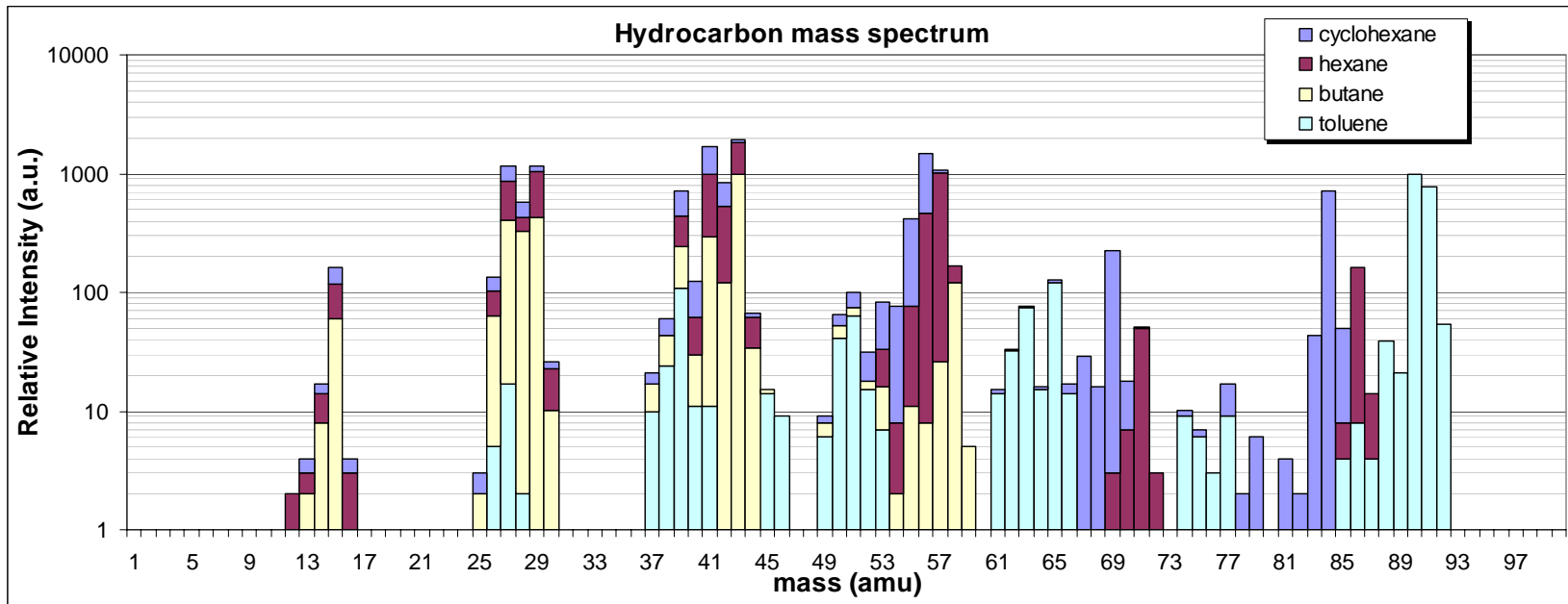
# Are All Hydrocarbons The Same?



n-alkanes on Pt.

- Initial rate of dissociation increases with increasing n-alkane chain length, up to C<sub>6</sub>.
- XPS indicates that dissociative adsorption of all alkanes produces same surface species on the surface, C<sub>a</sub> (not graphitic).

# Limitations of RGA



Hydrocarbon mass spectrum synthesised from standard cracking patterns.

- > Although ultimate sensitivity of RGA is very high,  $10^{-14}$  torr, there is always a trade-off with mass resolution.
- > Cross-sensitivity of RGA to less active or inactive hydrocarbon species combined with complex mass spectra, which can be very difficult to de-convolute, even when only a few simple hydrocarbon species are present, means that hydrocarbon level could be over estimated → consequences?

# Summary

- Is there a standard unit /method for hydrocarbon outgassing quantification?
  - In the absence of such do we need to define it.
- It's important to understand the vacuum environment of mirror reflectivity measurements in terms of how the tool will be monitored, i.e. with RGA, but considering limitations of RGA device perhaps necessary to conduct systematic investigation of mirror contamination due to specific active hydrocarbon species?
- BOCE would like to acknowledge Cambridge University chemistry department for carrying out XPS measurements.