Electron-beam-induced oxidation of benzene to phenol in $C_6H_6/O_2/Pt(111)$

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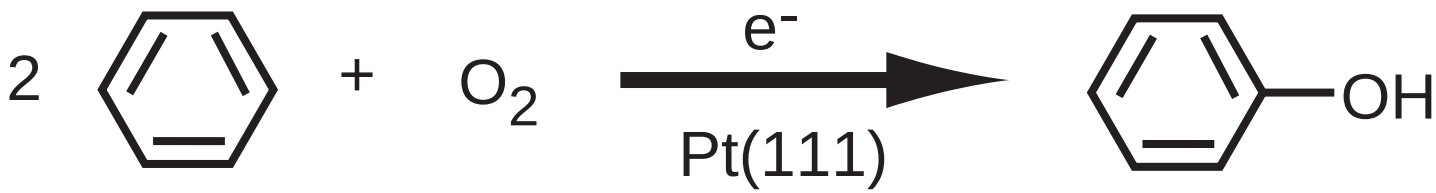
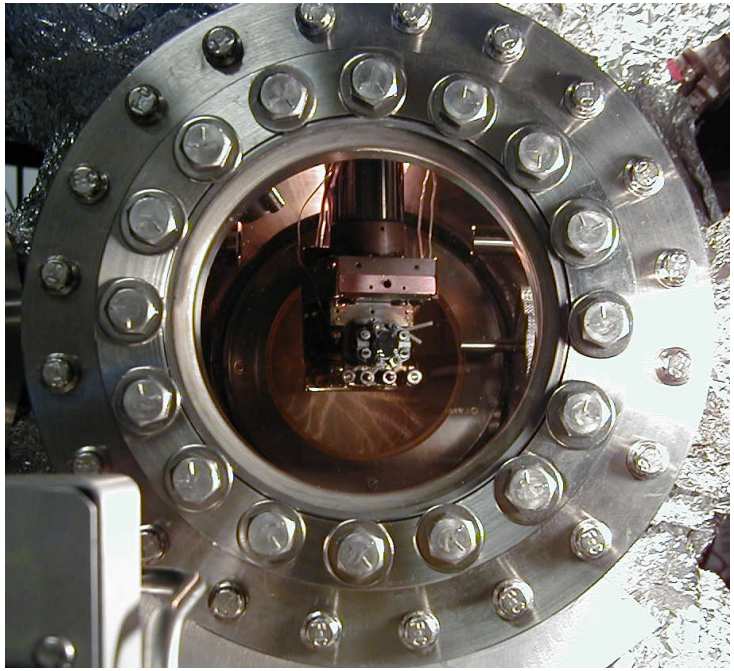
Introduction

Phenol: starting material in many synthetic reactions

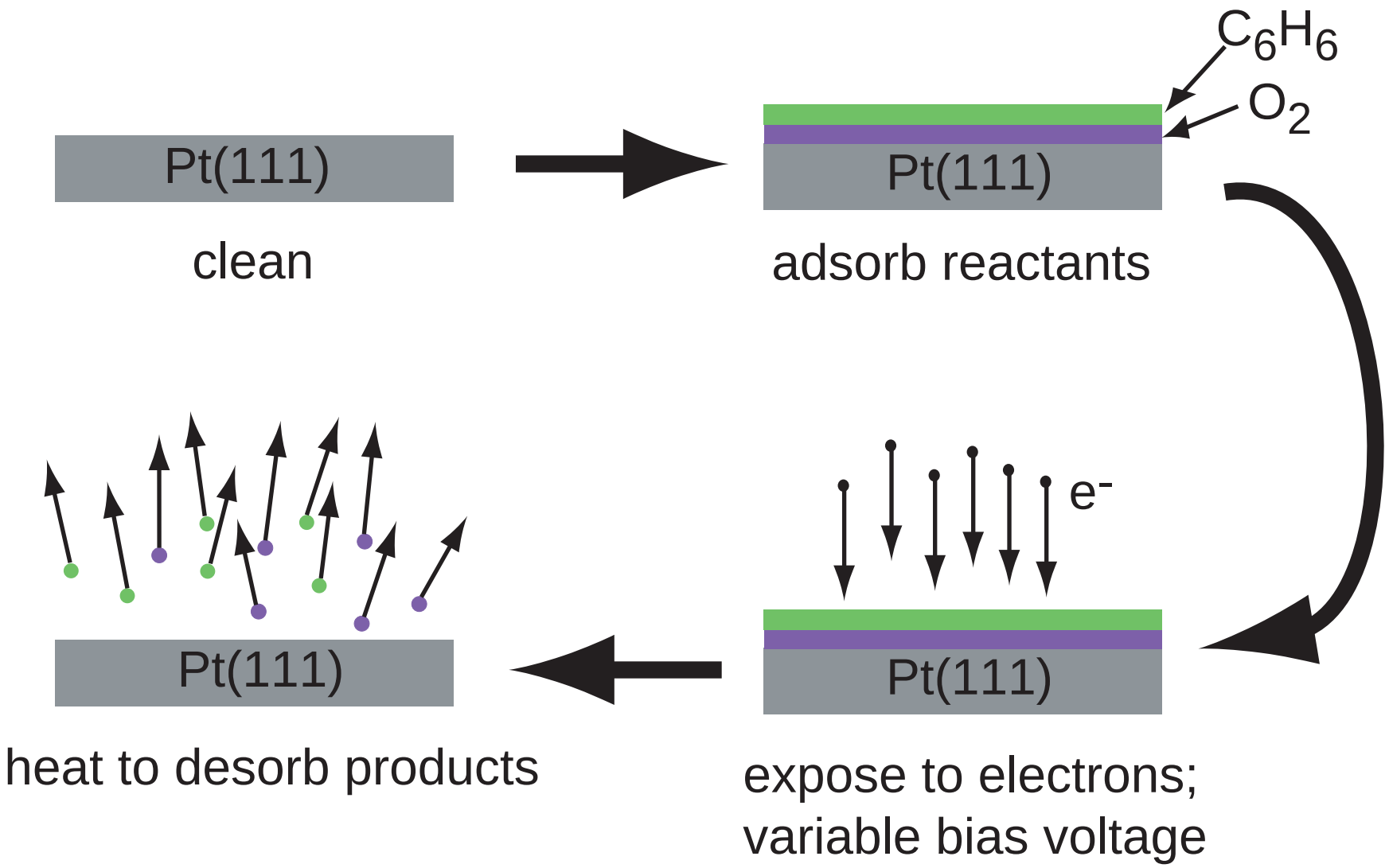


Apparatus

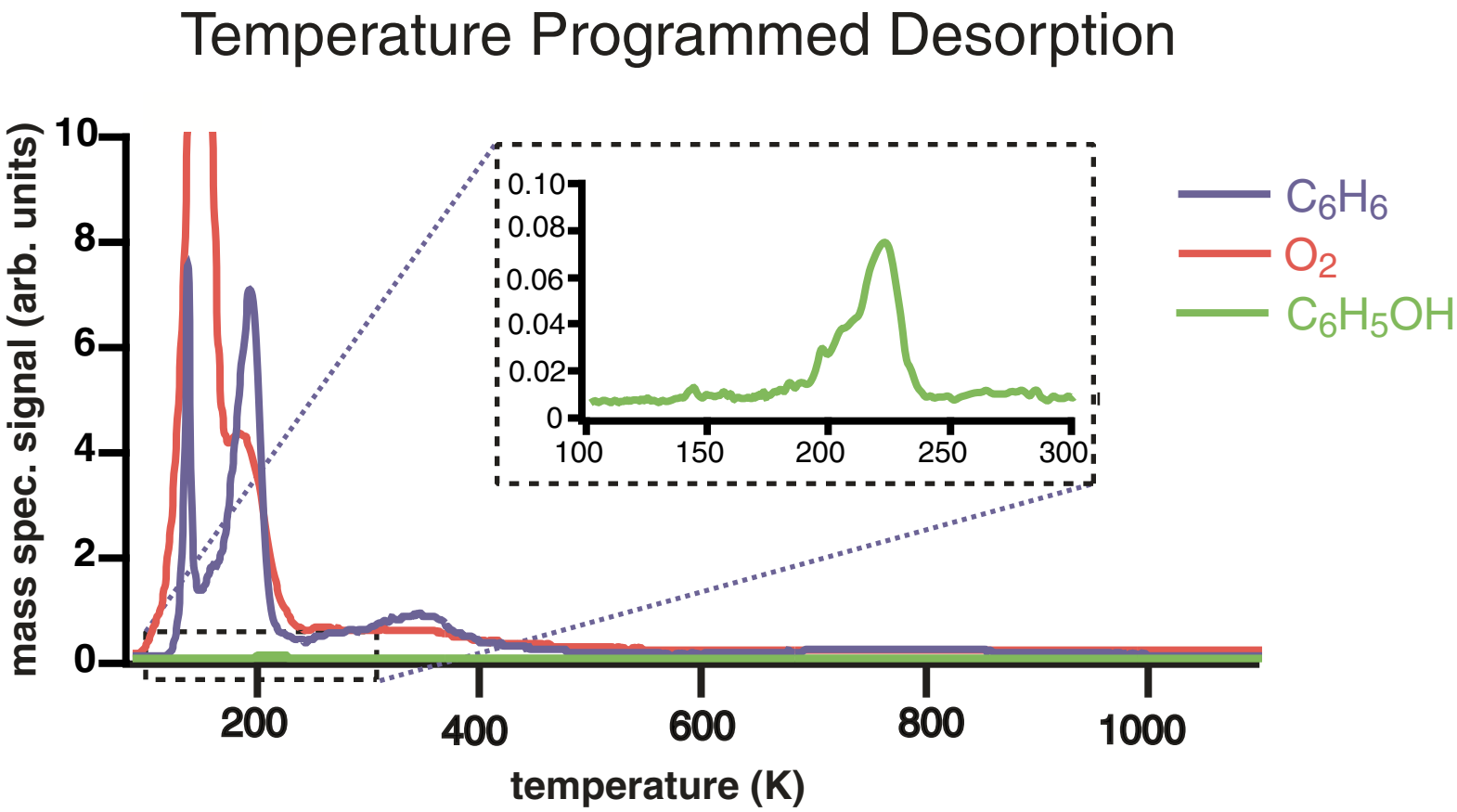


- base pressure ~ 10^{-10} torr
- temperature-controlled sample manipulation
- LEED/Auger instrument
- quadrupole mass spectrometer

Procedure

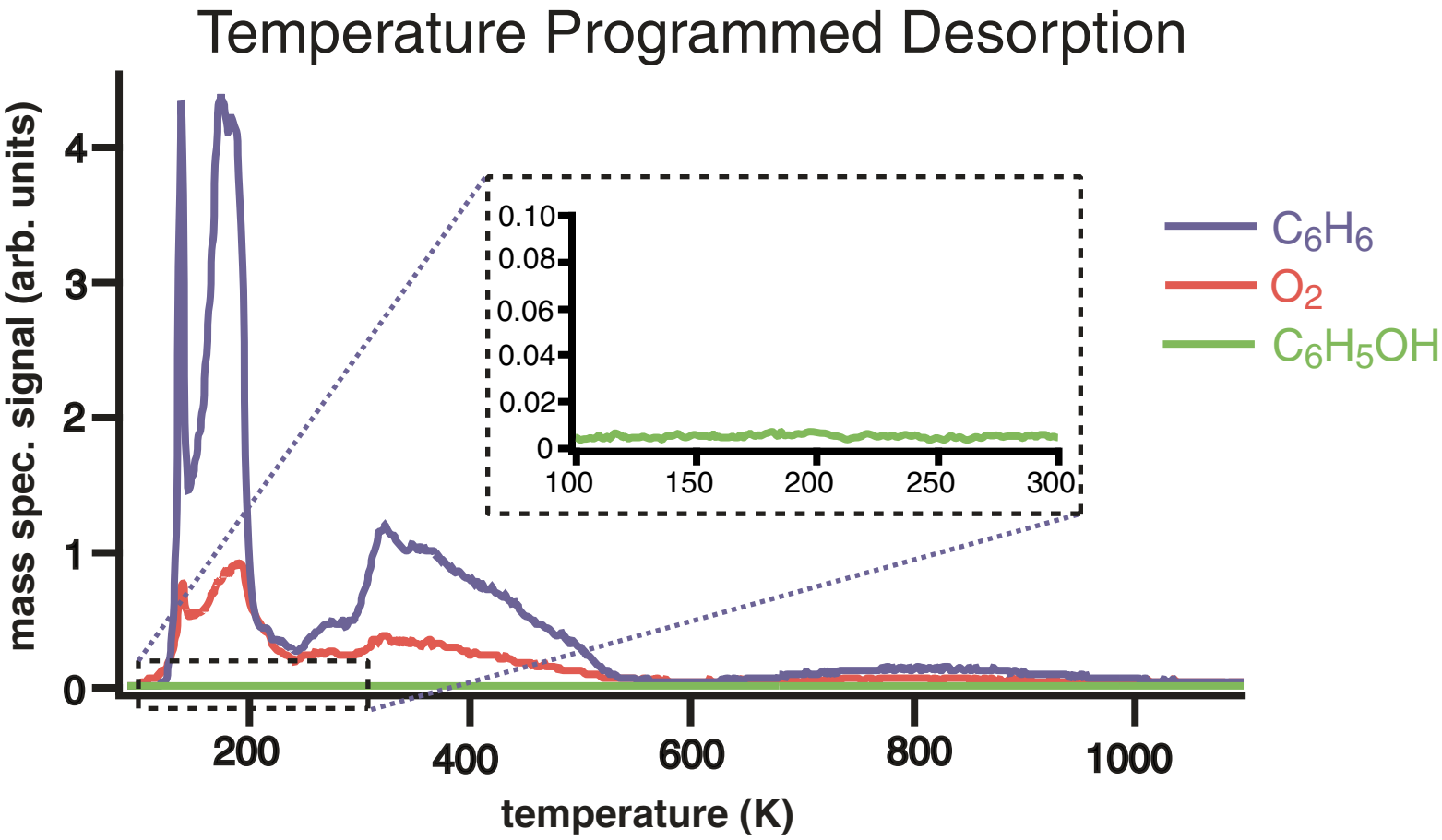

Pt(111)
clean
C_6H_6
O_2
Pt(111)
adsorb reactants
e^-
Pt(111)
expose to electrons;
variable bias voltage
Pt(111)
heat to desorb products

$C_6H_6/O_2/Pt(111)$ -- Phenol Observed



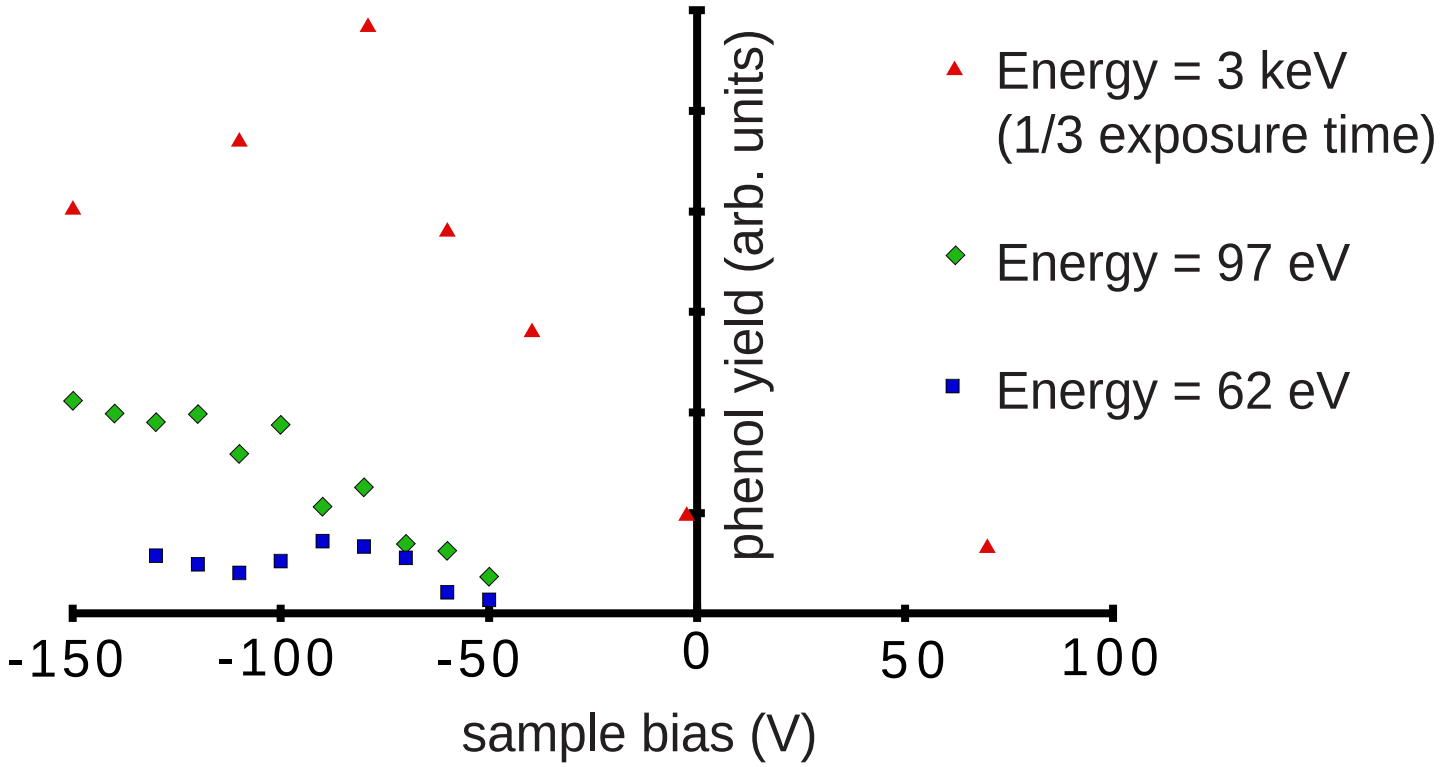
- benzene does not adsorb directly on Pt
- phenol is ~ 1% of desorbed benzene

$O_2/C_6H_6/Pt(111)$ -- Phenol Not Observed



- no phenol for low-energy exposures (100 eV)
- very little phenol for high-energy exposures (3 keV)

Bias-dependence of Phenol Yield



electrons do not need to hit the sample to make phenol

Possible Explanations

- ions not created from background gas
  - pressure too low
  - signal not enhanced by addition of H_2, N_2, CO, or O_2 gas
- impact of e^- on grounded sample holder

Summary

- phenol formed from $C_6H_6/O_2/Pt(111)$ under electron exposure
- little or no phenol from $O_2/C_6H_6/Pt(111)$
- not necessary for e^- to impact sample to produce phenol
- mechanism under investigation