Stable Free Radicals and Potential Implications for Health Effects of Diesel Emissions

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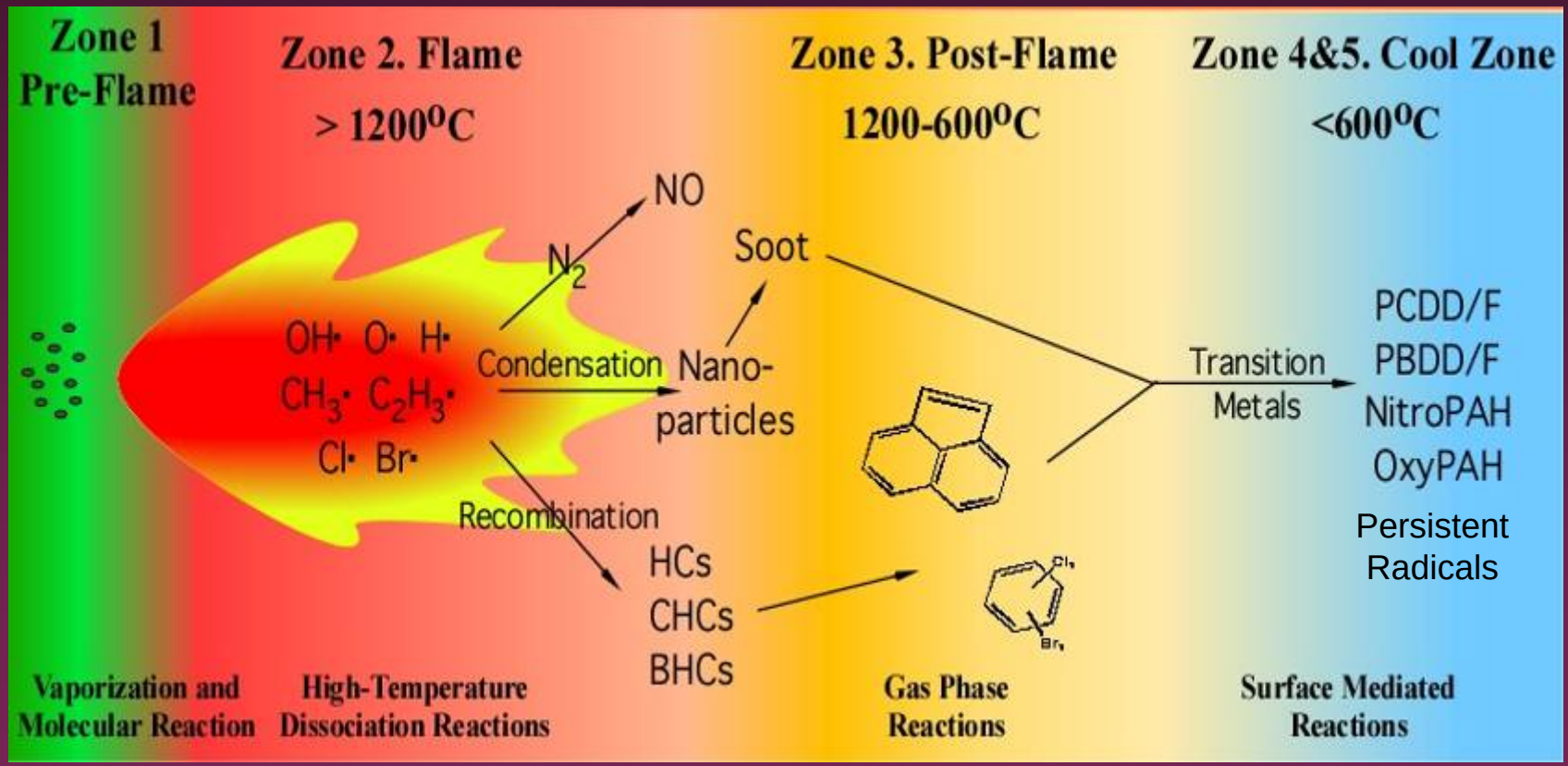
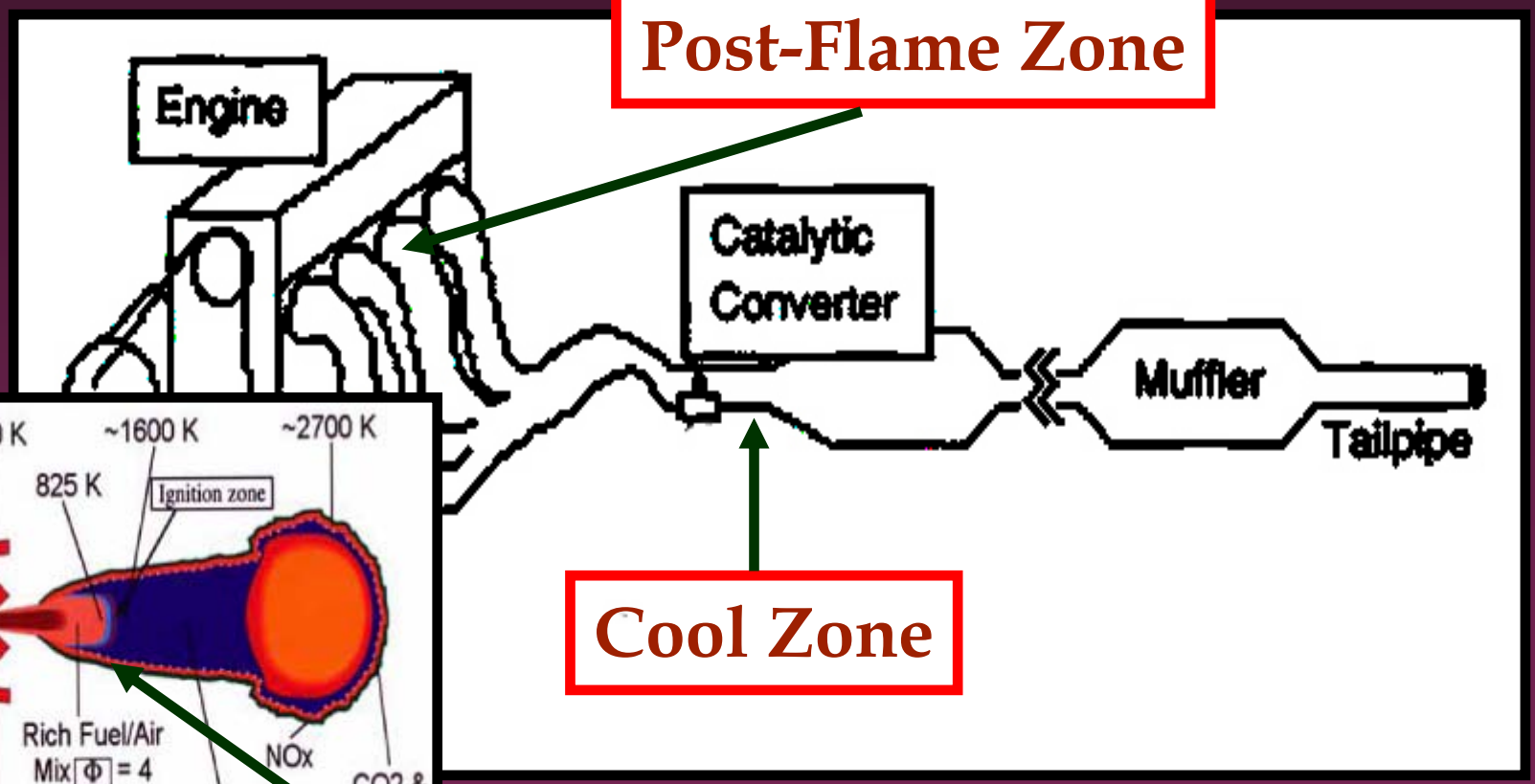
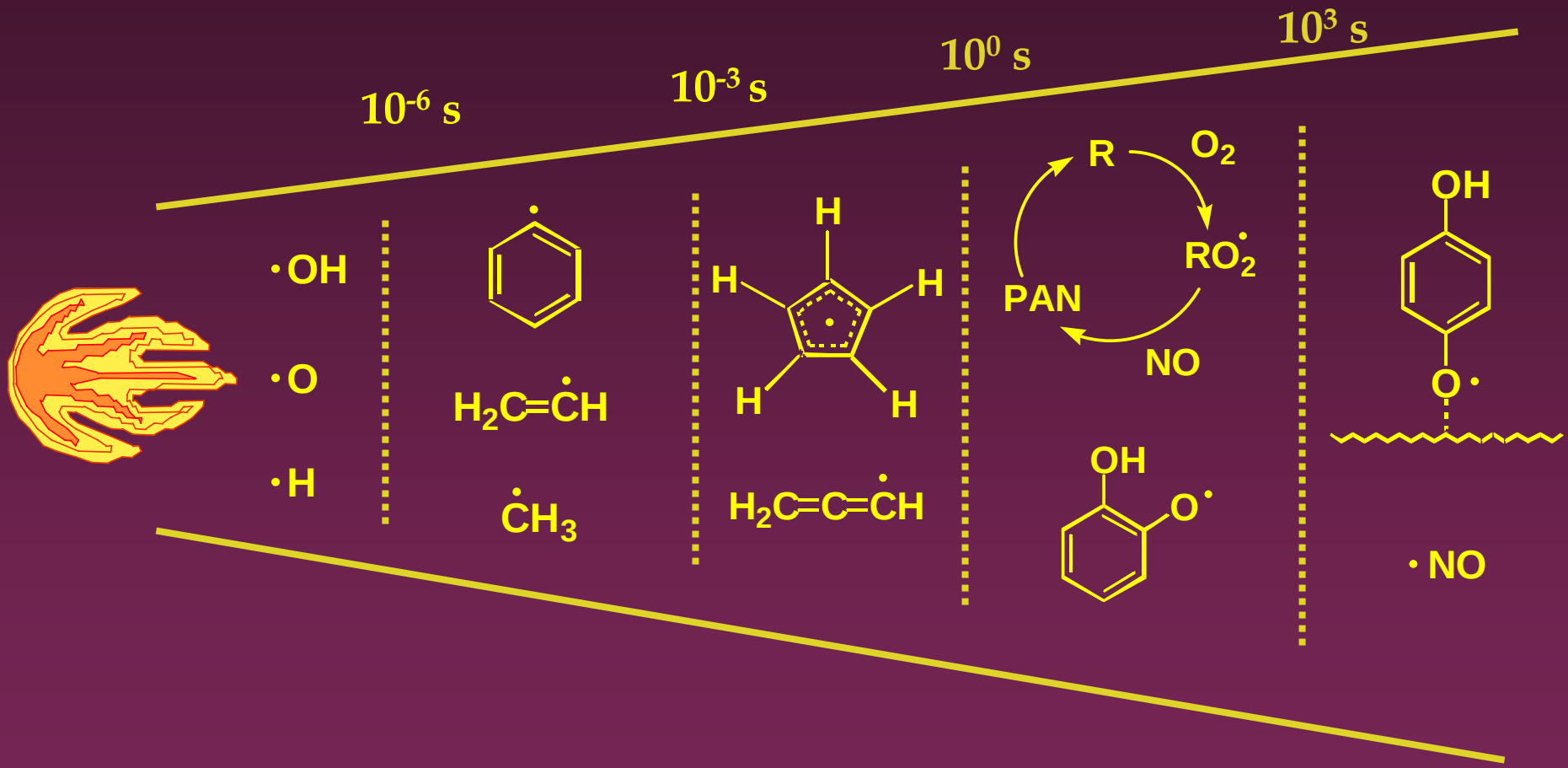
Chemical Reaction Zones in a Combustion Device



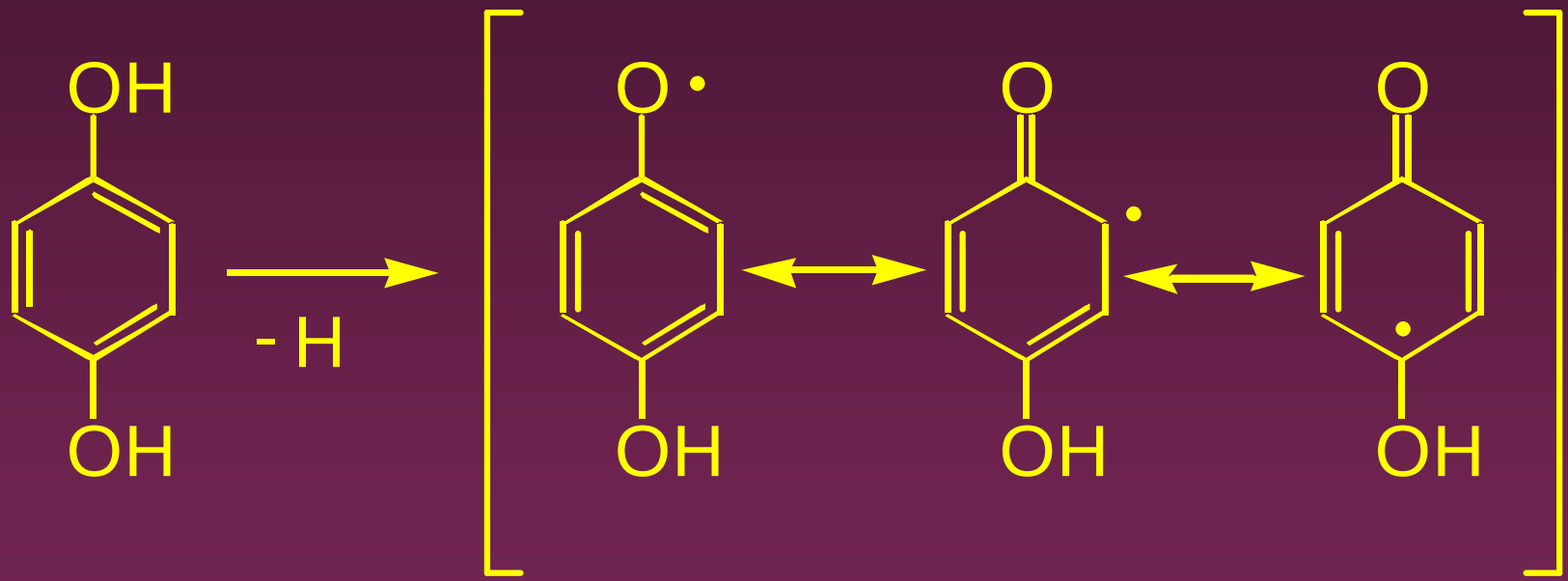
Chemical Reaction Zones in an Automotive Engine System



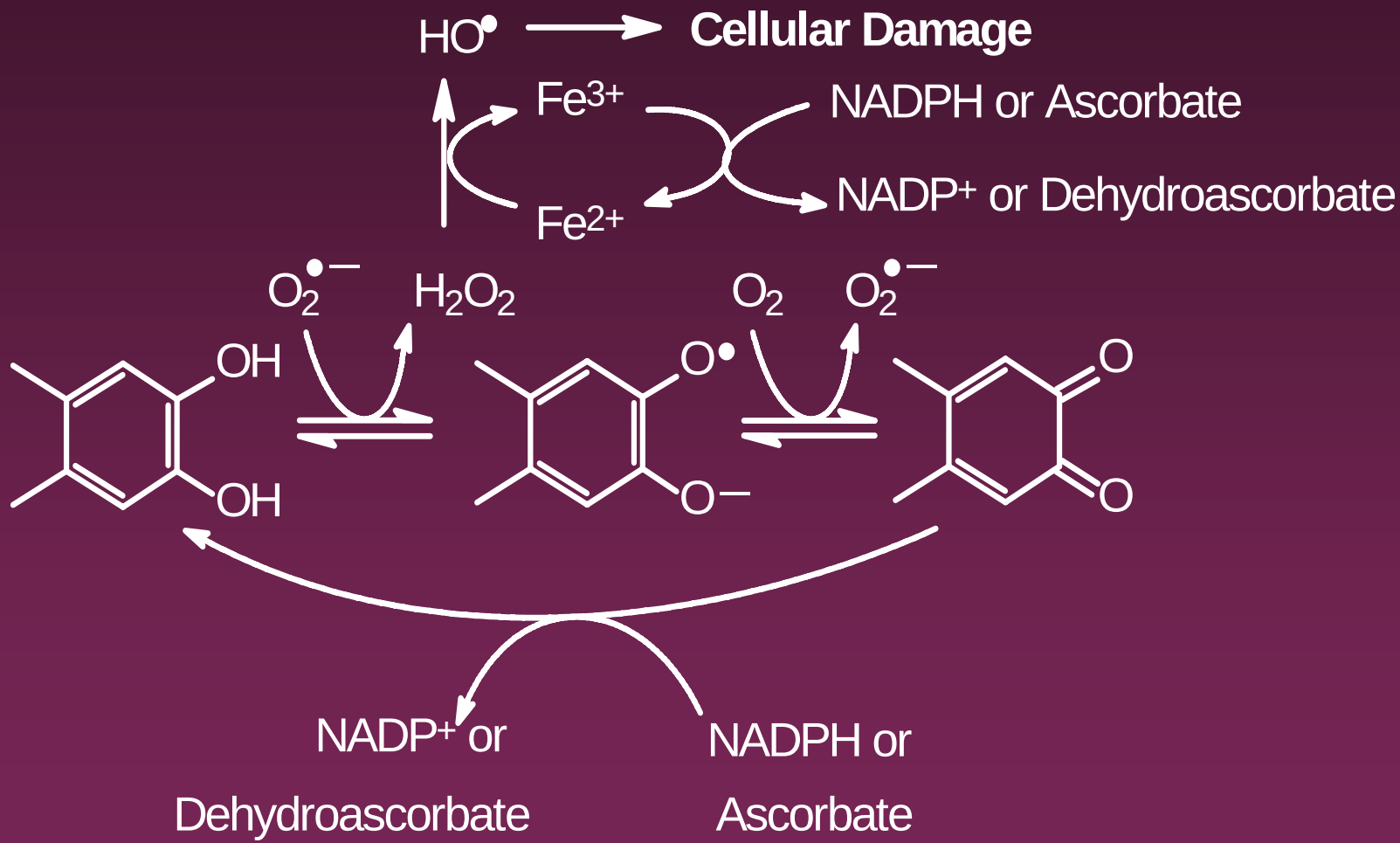
Radical Stabilities/Reactivities



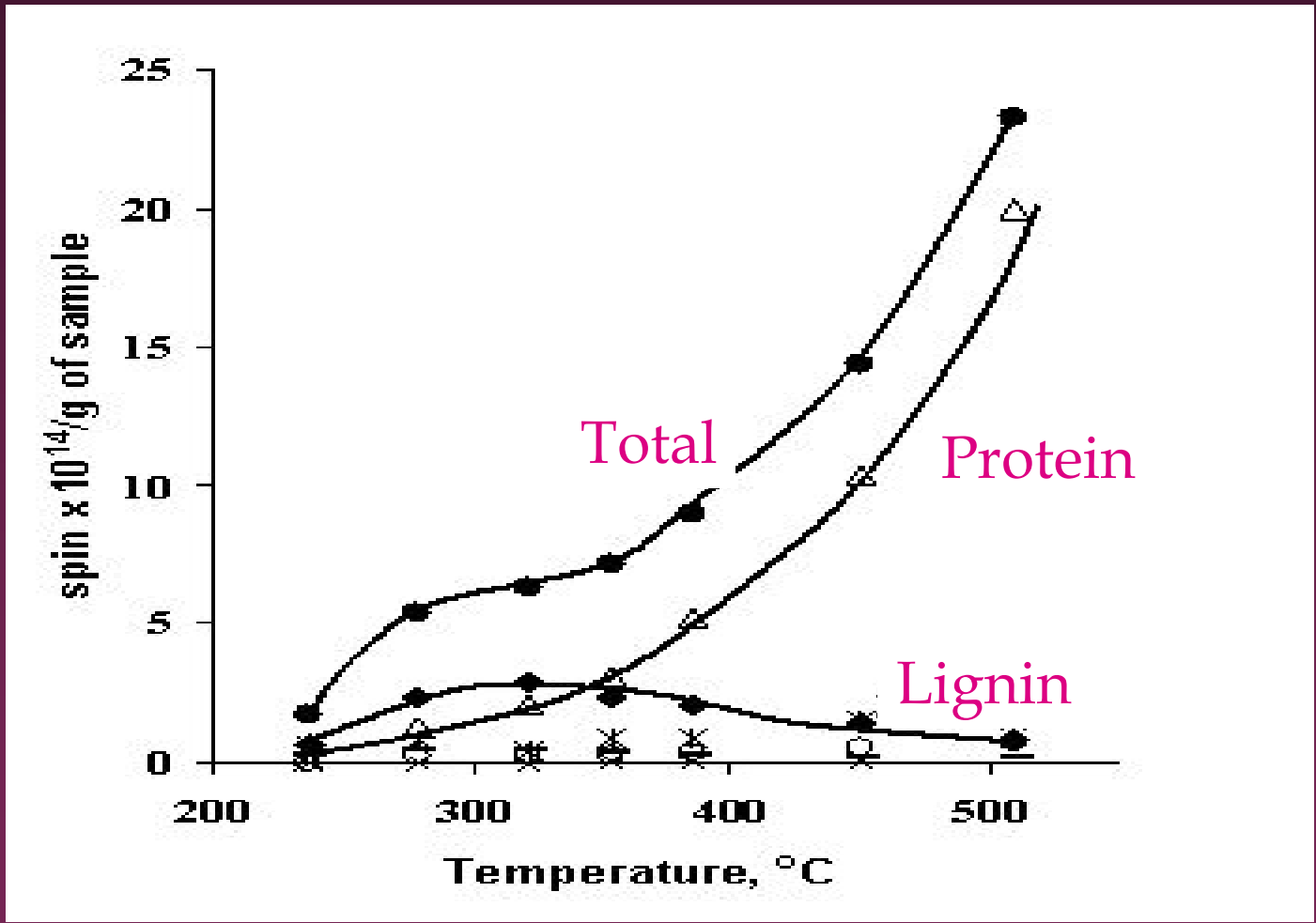
Resonance Stabilized Semiquinone Radicals



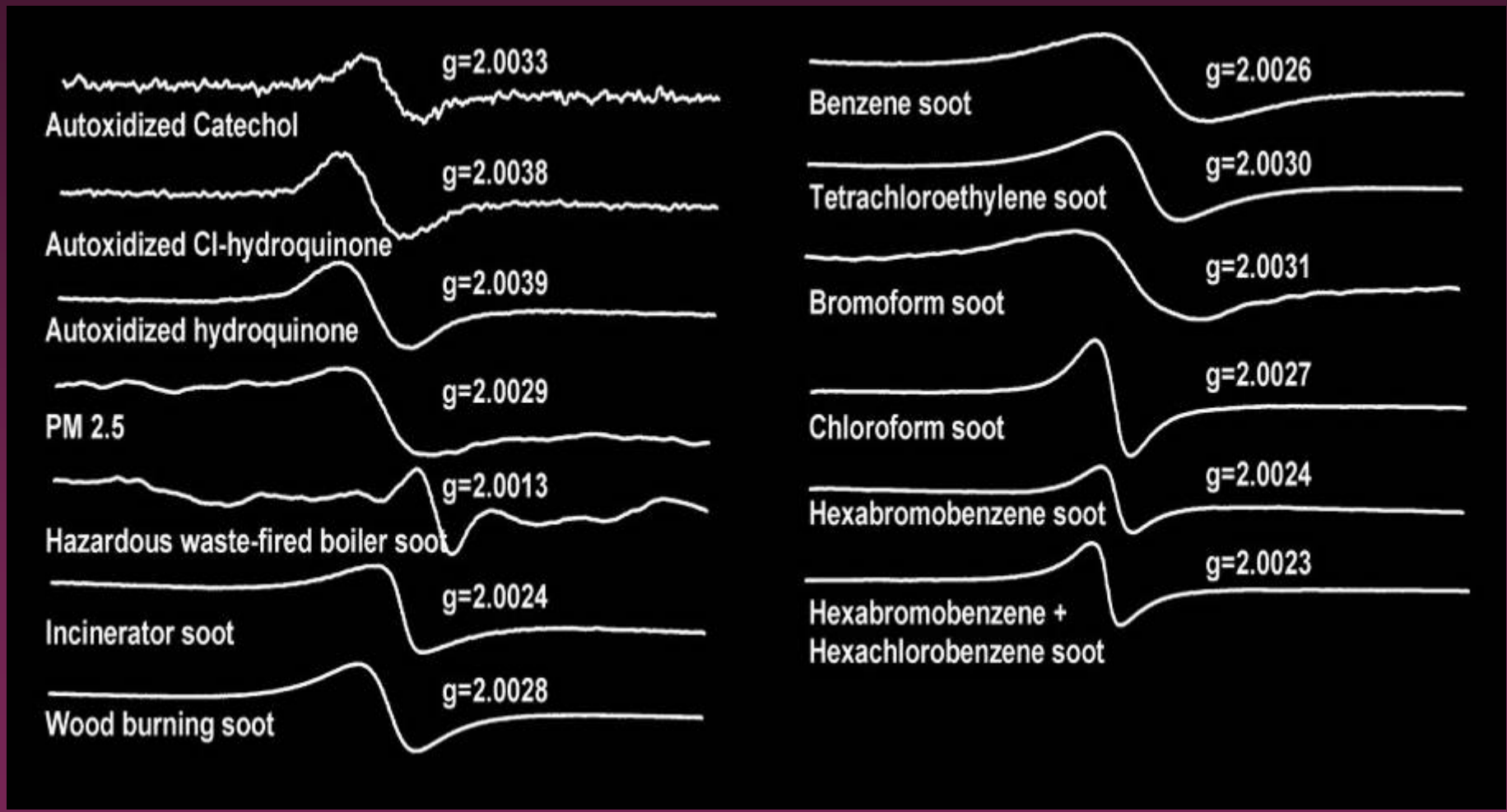
Oxidative Cycles of Semiquinones



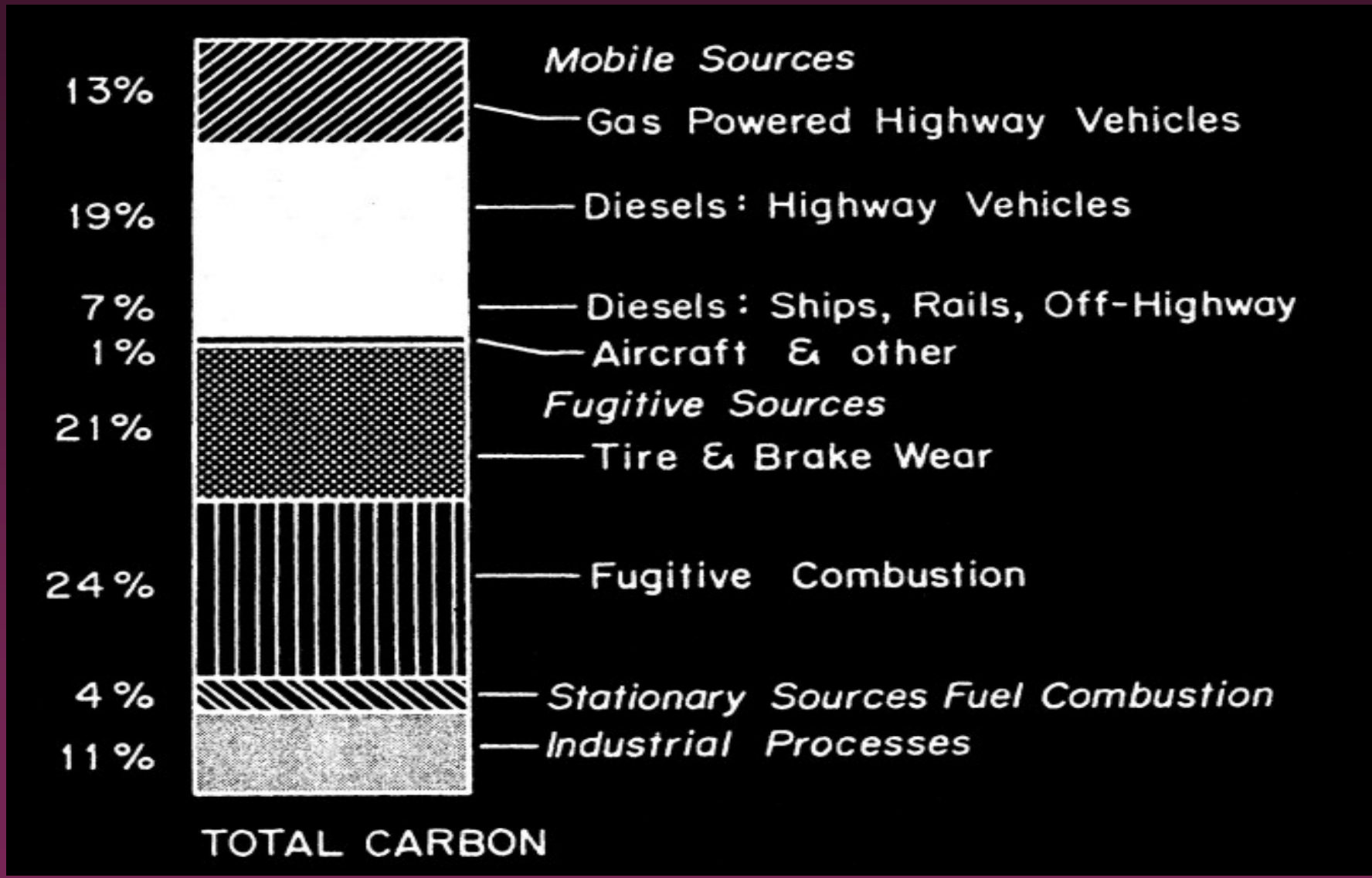
Tobacco Components Producing Radicals



EPR Spectra of Combustion-Generated Particles

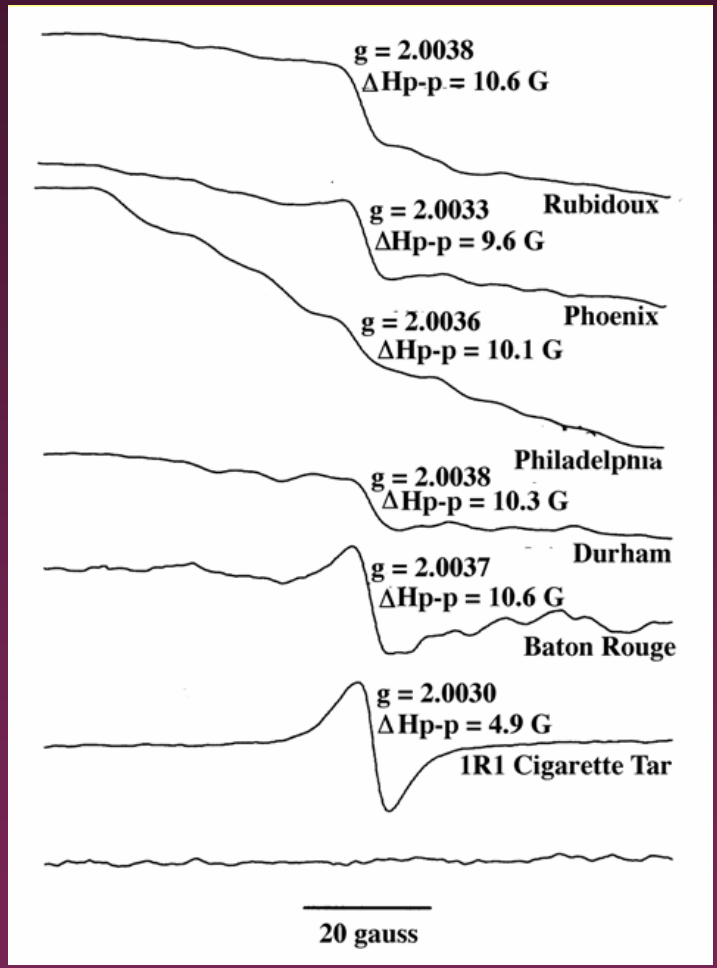


Source Distribution of PM2.5



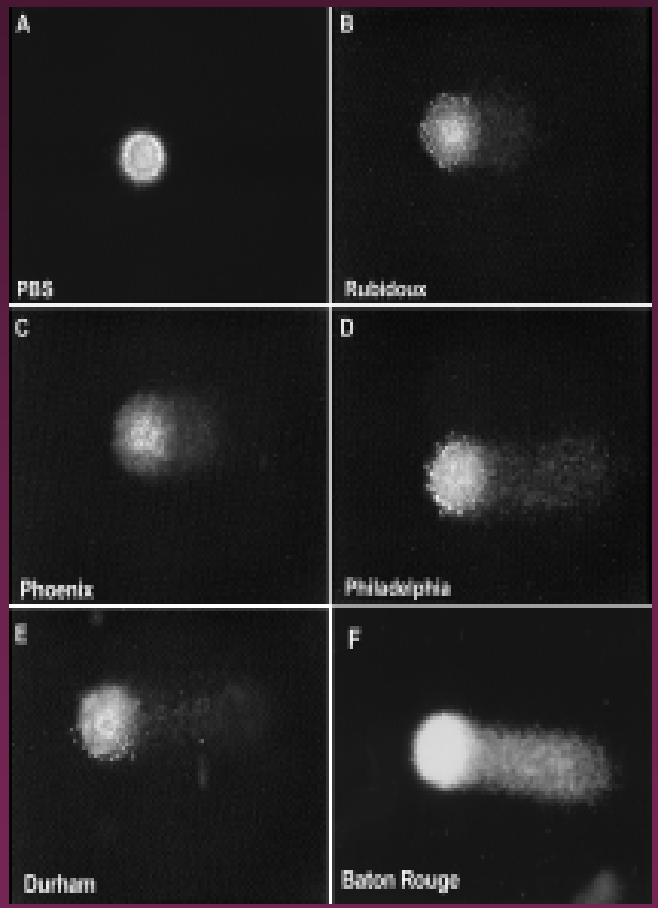
Adapted from Gray and Cass, 1998

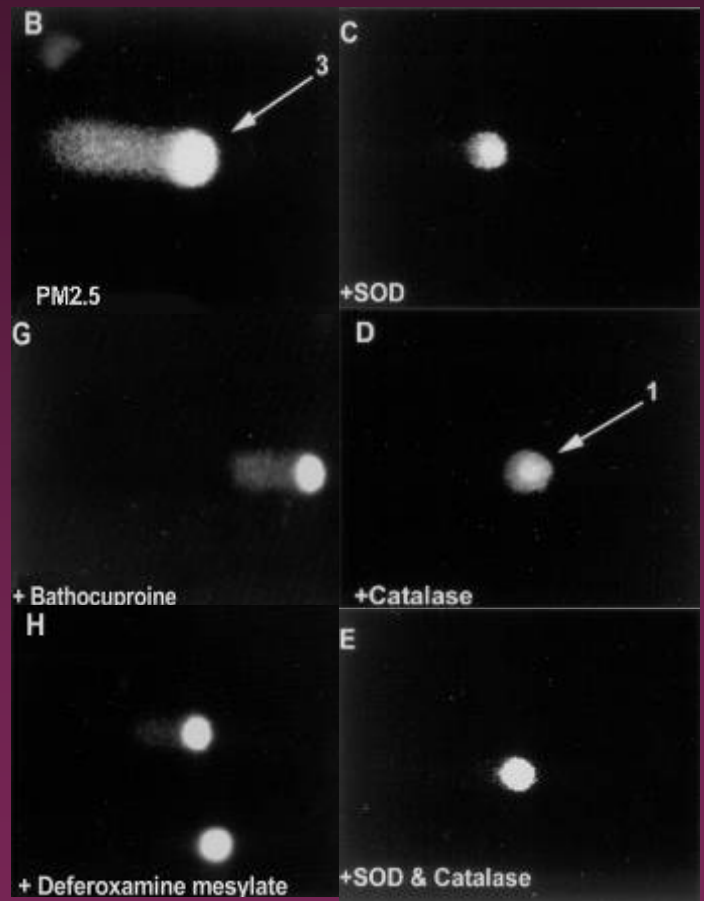
EPR Spectra of PM2.5 Samples



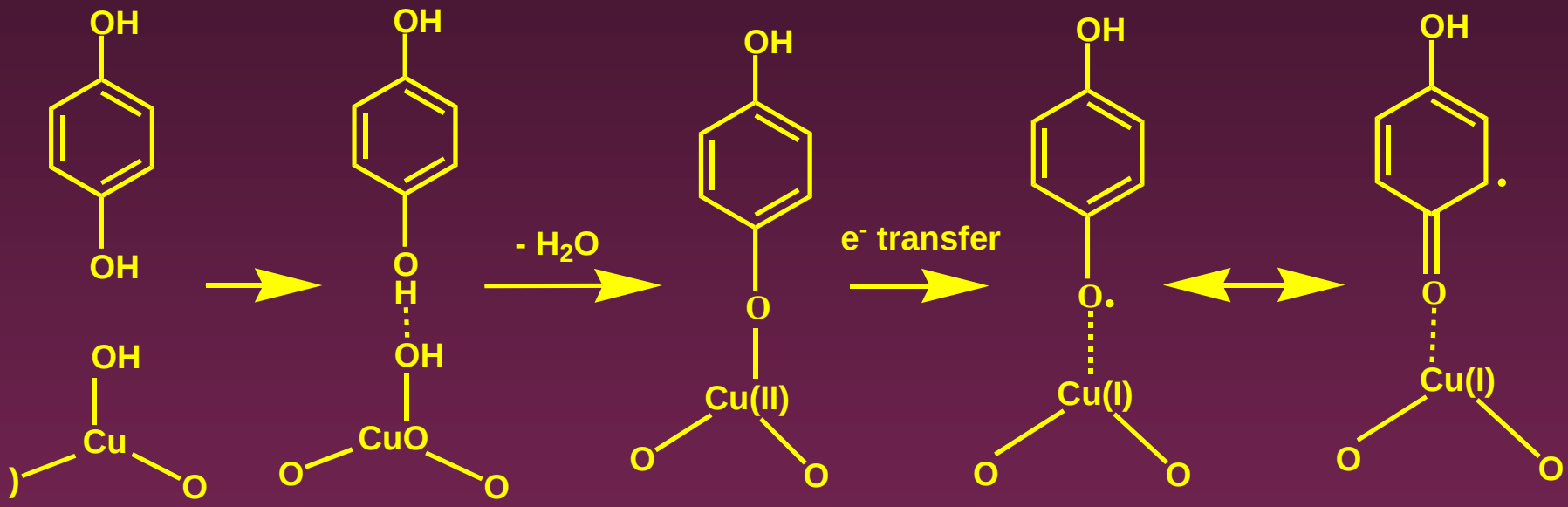
Lung Epithelial Cell Damage

Incinerator Fly-ash **5 City PM2.5** **Baton Rouge PM2.5**

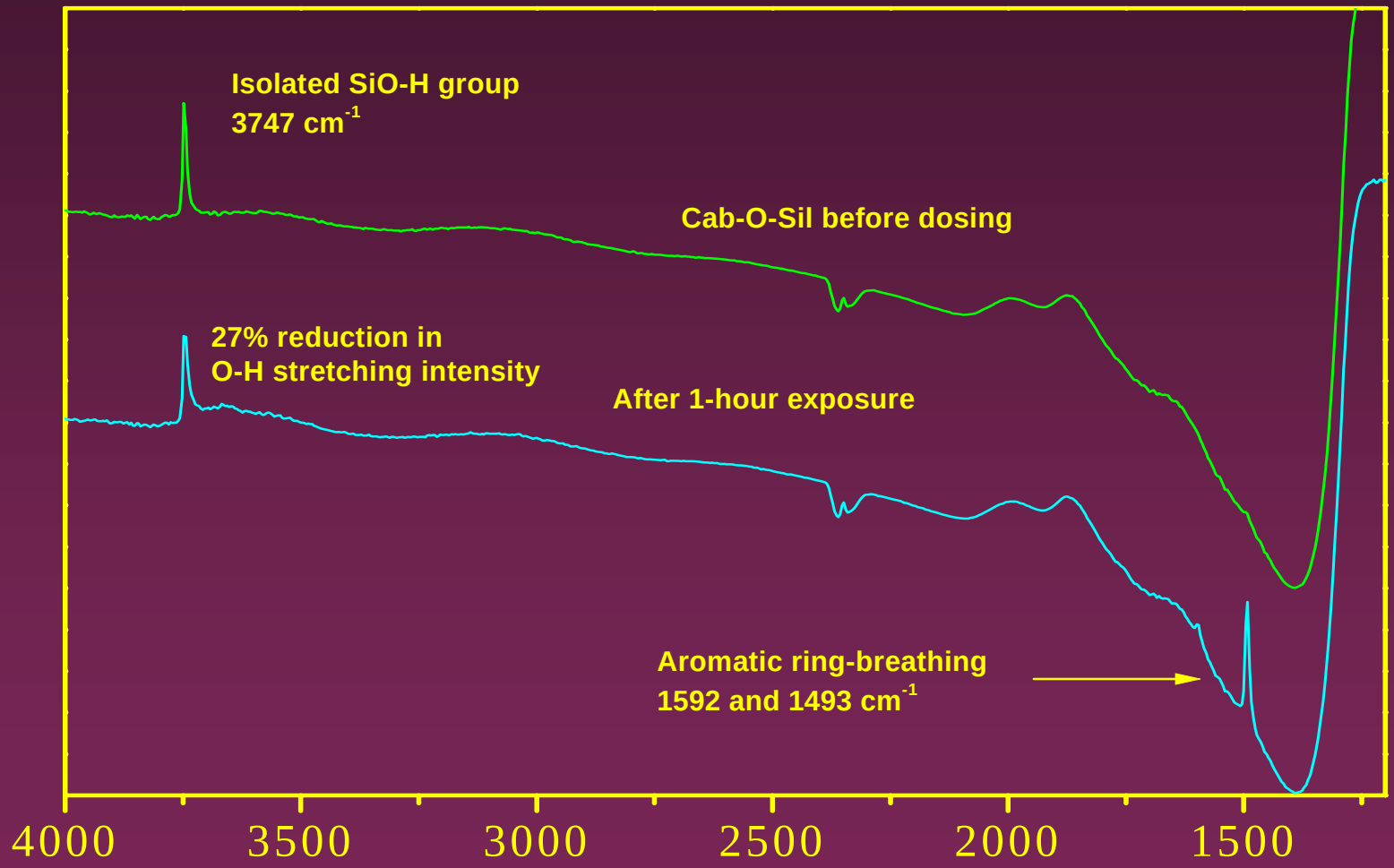




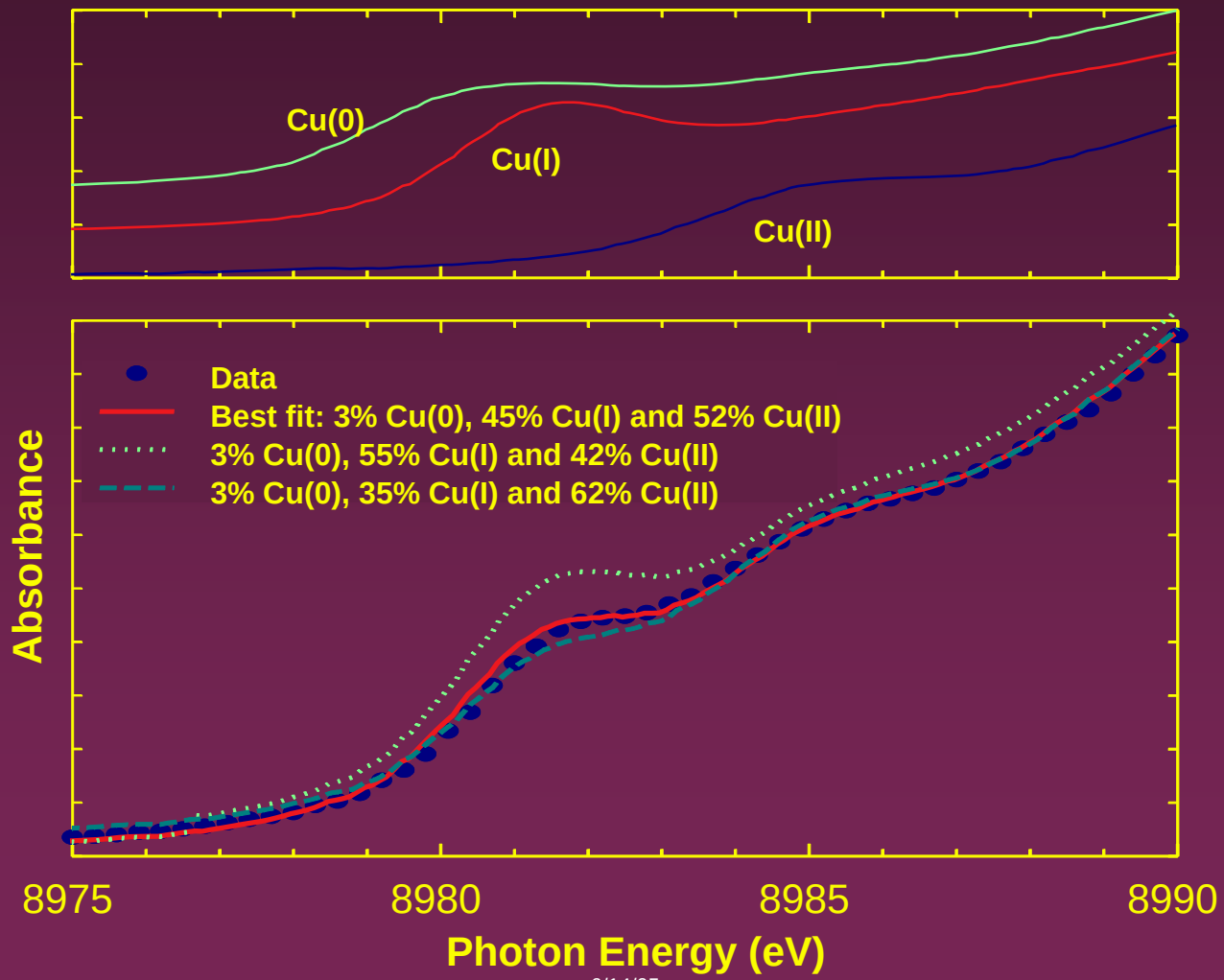
Stabilization Mechanisms



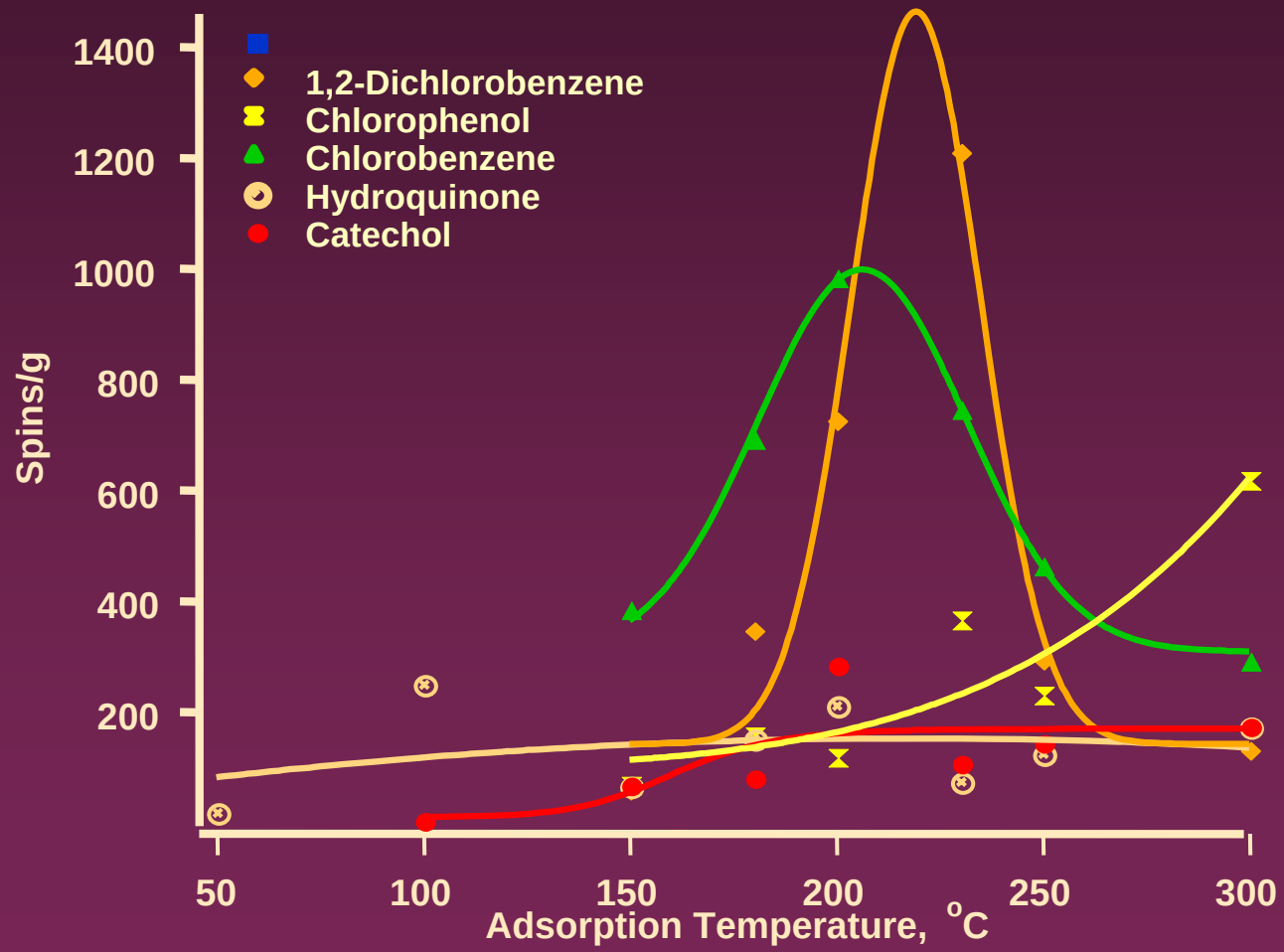
FTIR Spectra of 2-Chlorophenol on Silica at 350 C



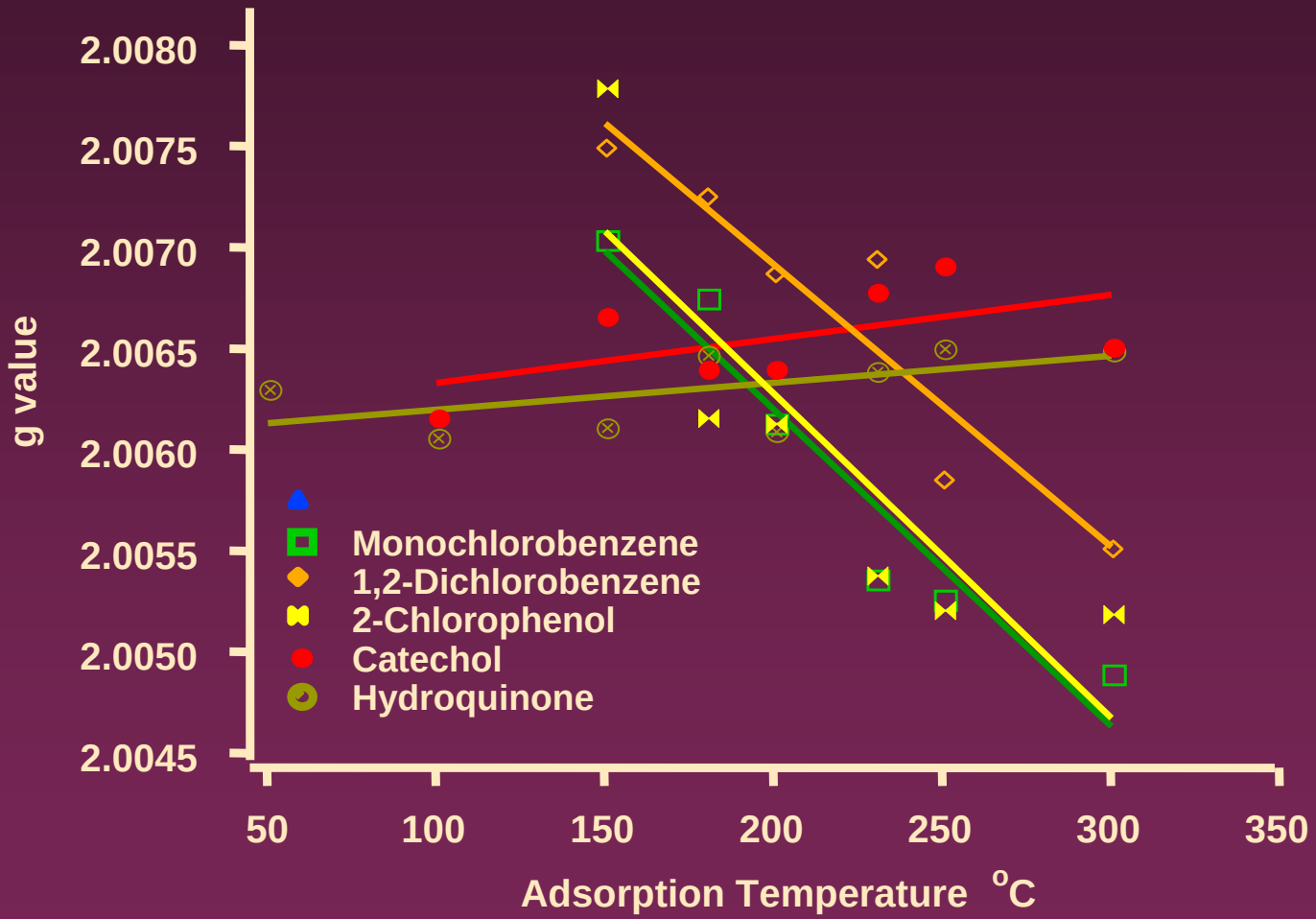
XANES Spectra of CuO/Silica Reduction by Phenol



Radical Yields on 5% Cu(II)O/Silica

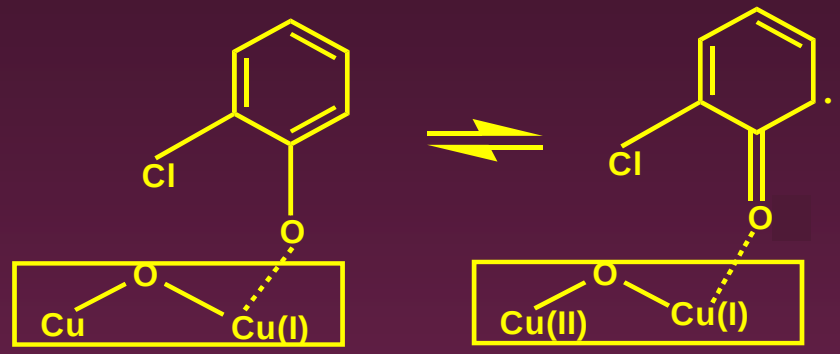


Radical g-Values on 5% Cu(II)O/Silica

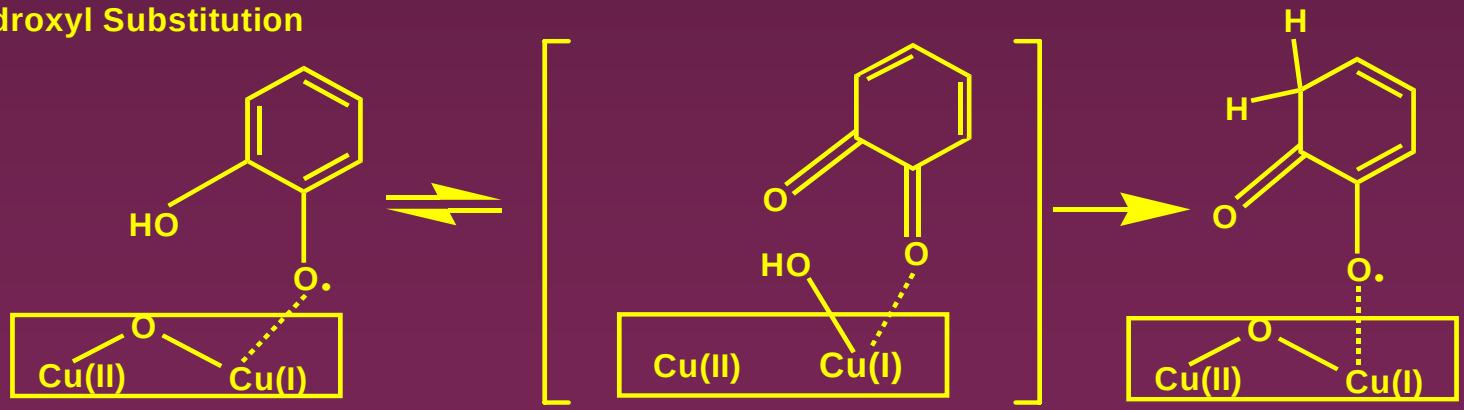


Substitution Effect on Radical Structure

Chlorine Substitution

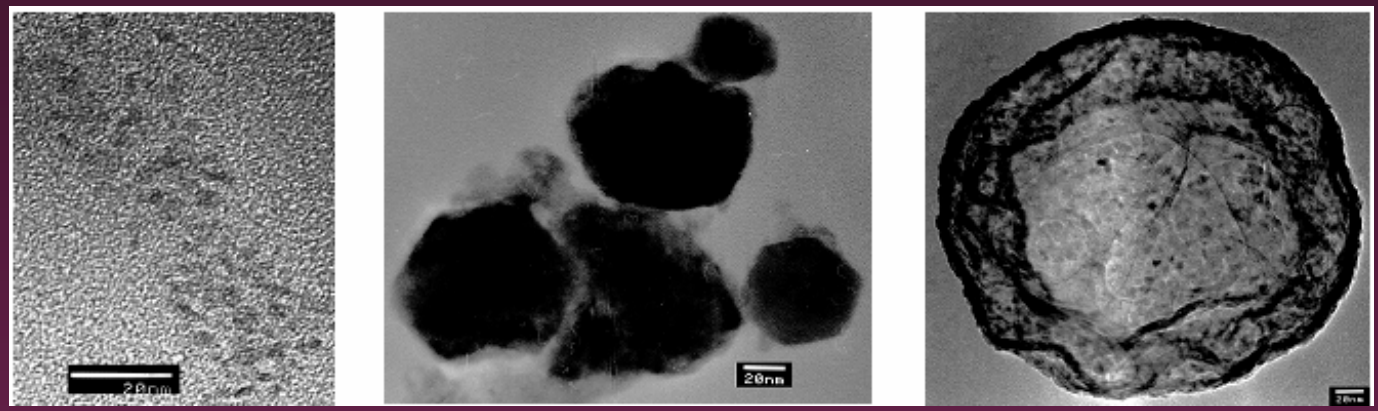


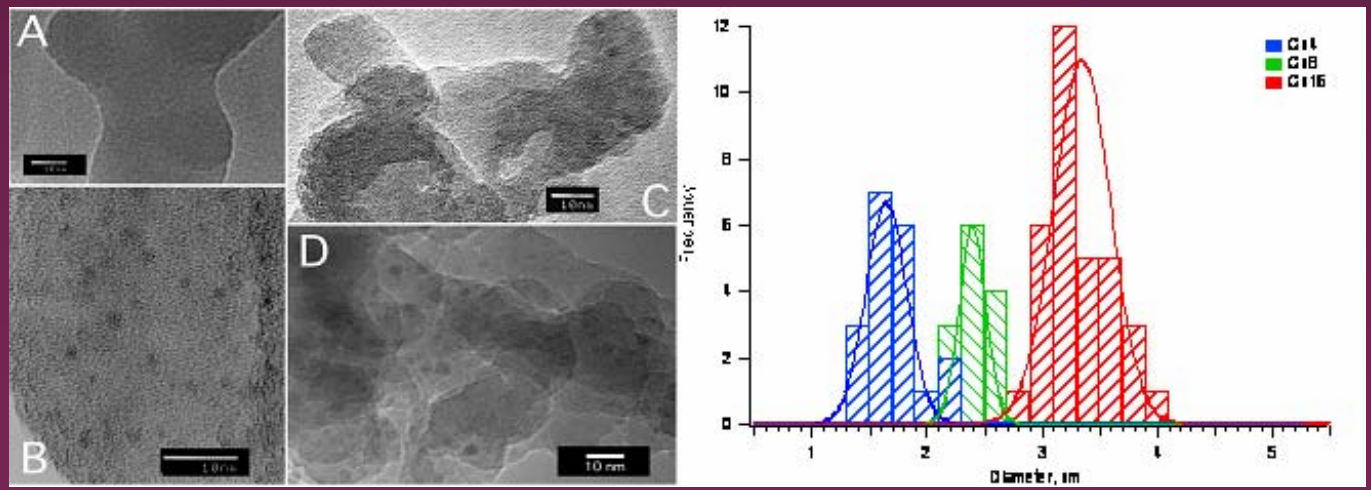
Hydroxyl Substitution



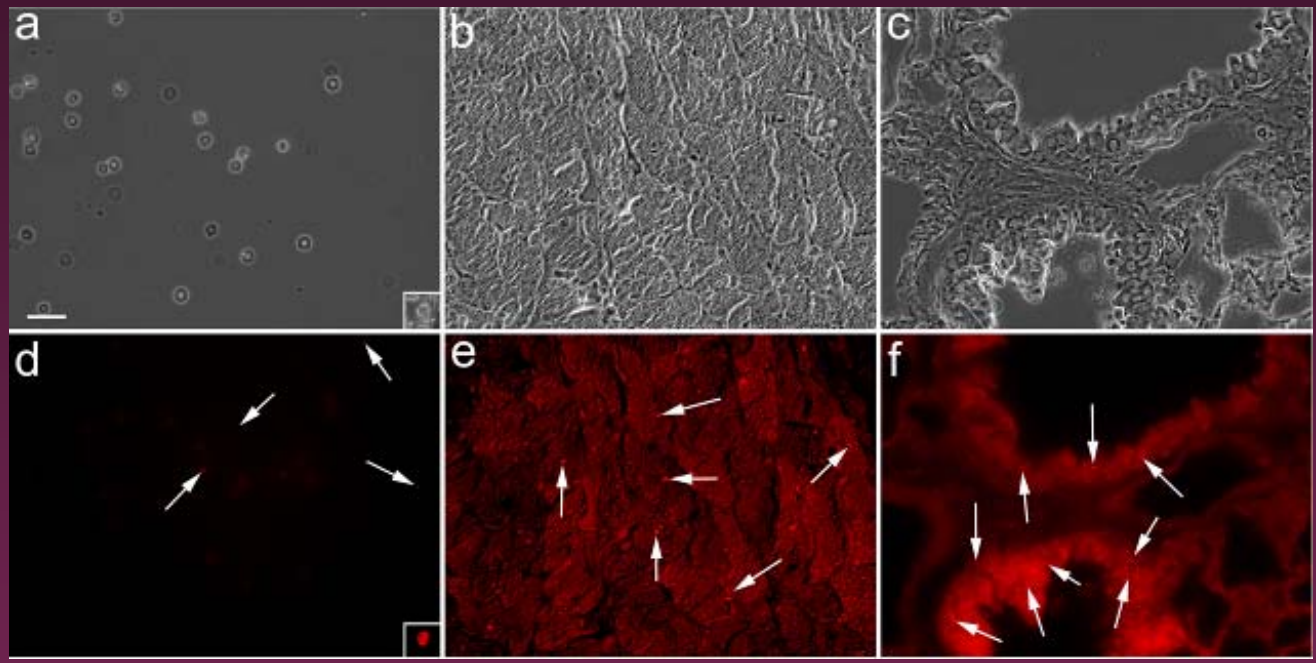
Engineered Nanoparticle Surrogates

~5 nm CuO ~30 nm CuO CuO/Carbon



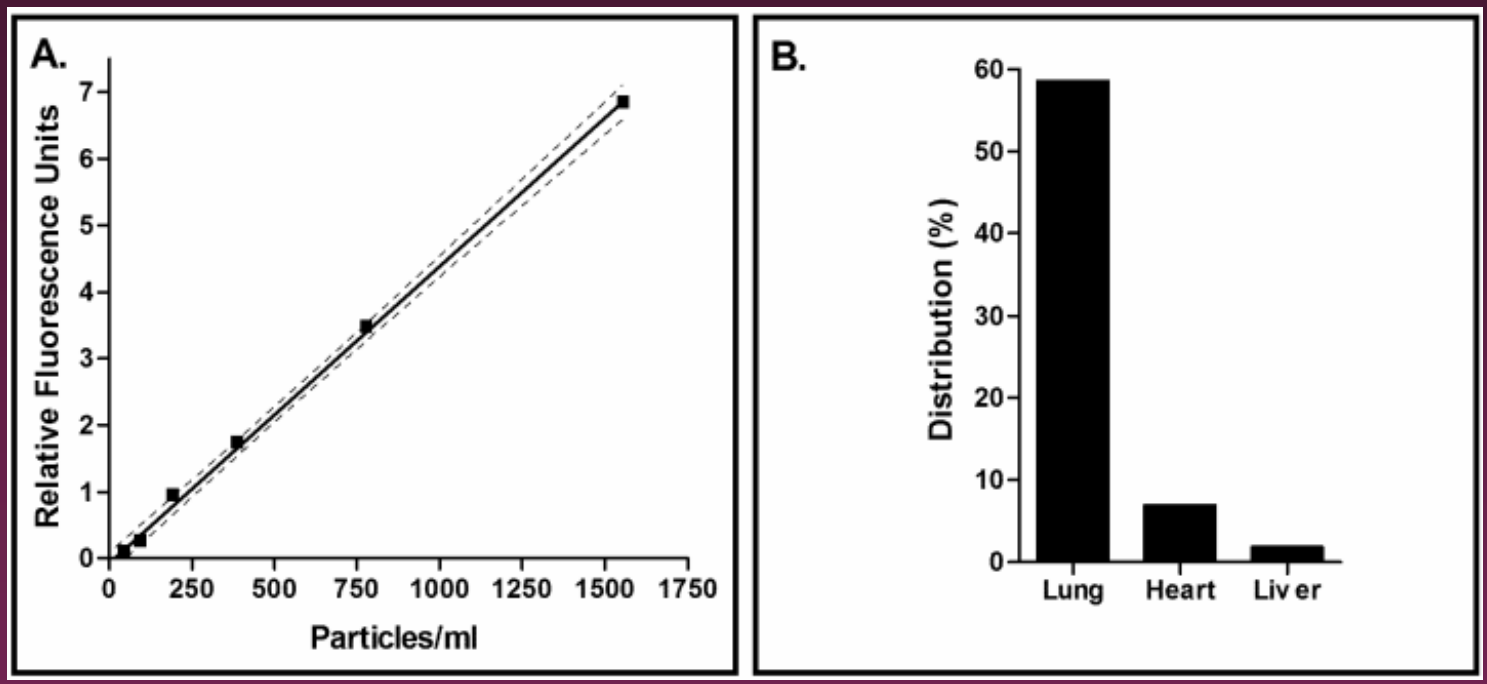


Nanoparticles Diffuse from the Lung into the Blood and Tissues



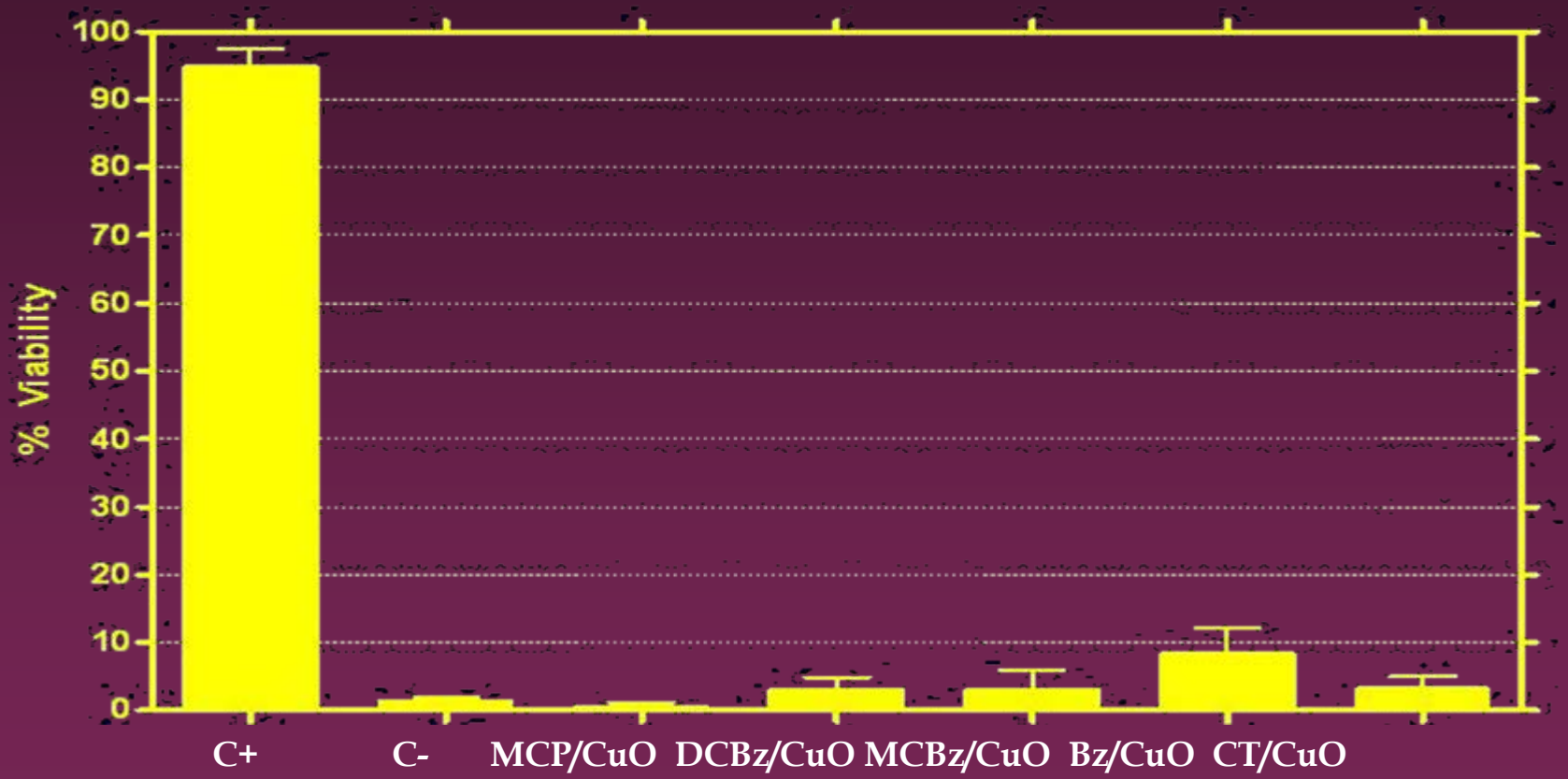
$FMS_{0.5}$ suspended in 50 μl sterile, isotonic saline (1μg/μl) were instilled into the lungs of mice. **At 24 h,** , the mice were euthanized and exsanguinated. Peripheral blood and tissues were isolated. FMS were seen freely floating in the **(a,d) peripheral blood** (inset: FMS-laden macrophage; **(b,e) within the myocardial tissue**; and **(c,f) within cells of the airways**. (a,b,c) Brightfield images. (d,e,f) Fluorescent images: excitation/emission at 560/610 nm. Arrows indicate representative FMS0.5 in tissues. Scale bar = 20μm.

Biodistribution of $FMS_{0.5}$ 30 min After Intratracheal Instillation



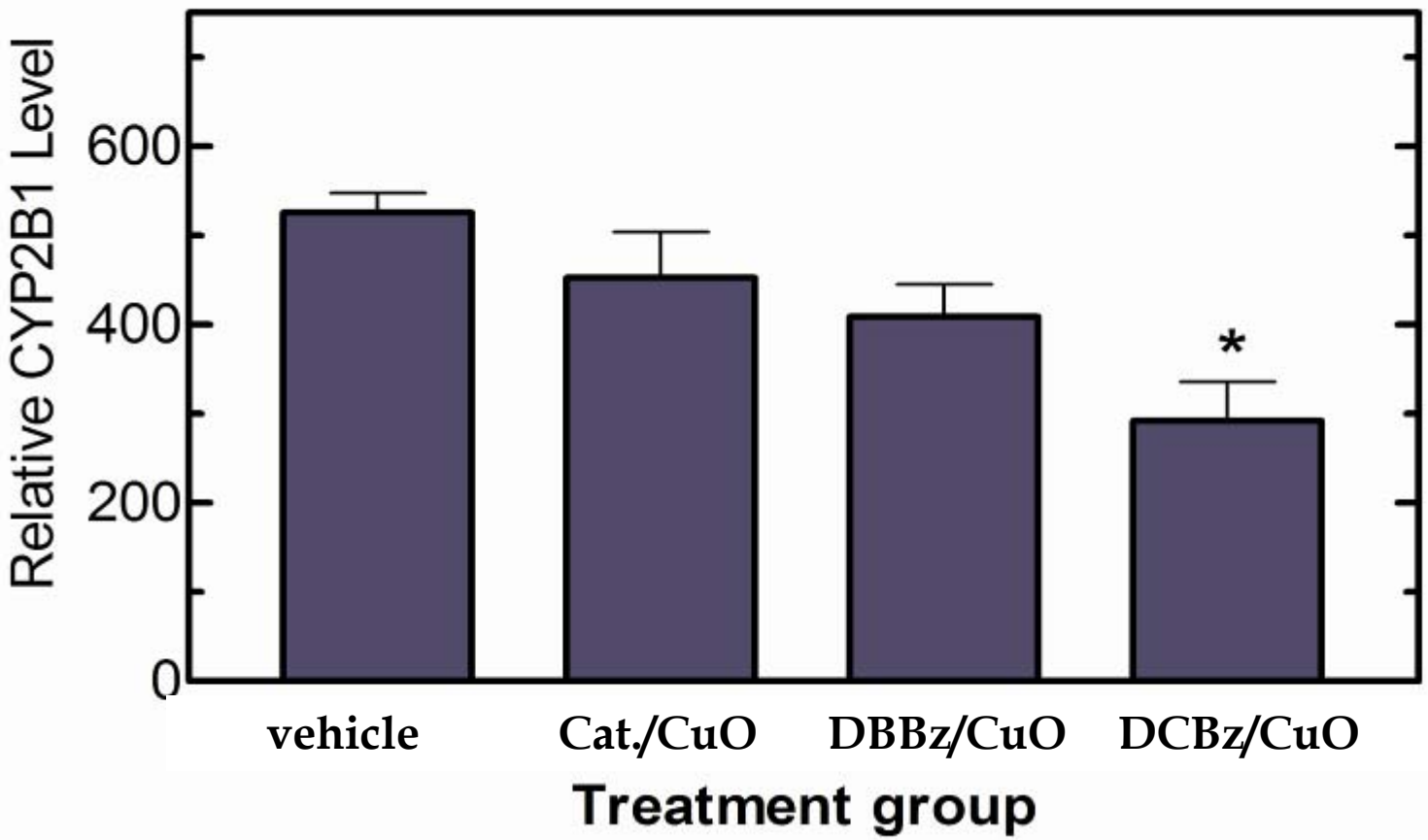
A) Standard curve of FMS_1 in isotonic saline containing 0.02% tween-80. The FMS_1 standard curve was linear from 49 – 1562 particles/ml Mean values (■) ± Cl plotted (n=3; r2=0.9987). **B)** Approximately 60%, 7%, and 2% of the total instilled dose was observed in the lungs, heart, and liver; respectively Values in the organs are percentages of the total dose of FMS_1 administered to the mouse.

Surrogates Reduce Epithelial (and Myocardial) Cell Viability

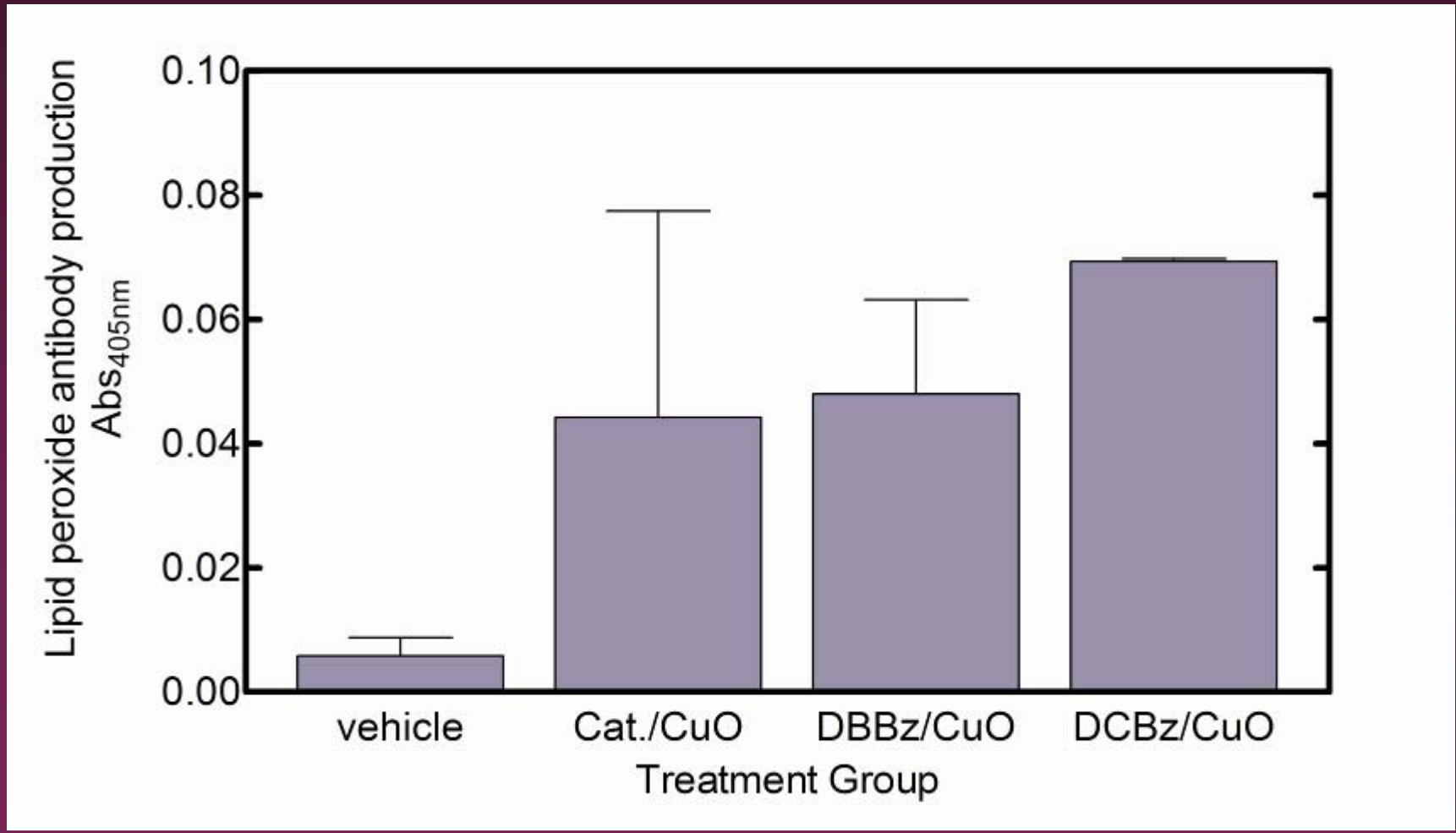


5,000 cells/well plated 24 hrs prior to exposure
176 ug exposure for 24 hrs
3 wells/sample
chemisorbed @ 230°C

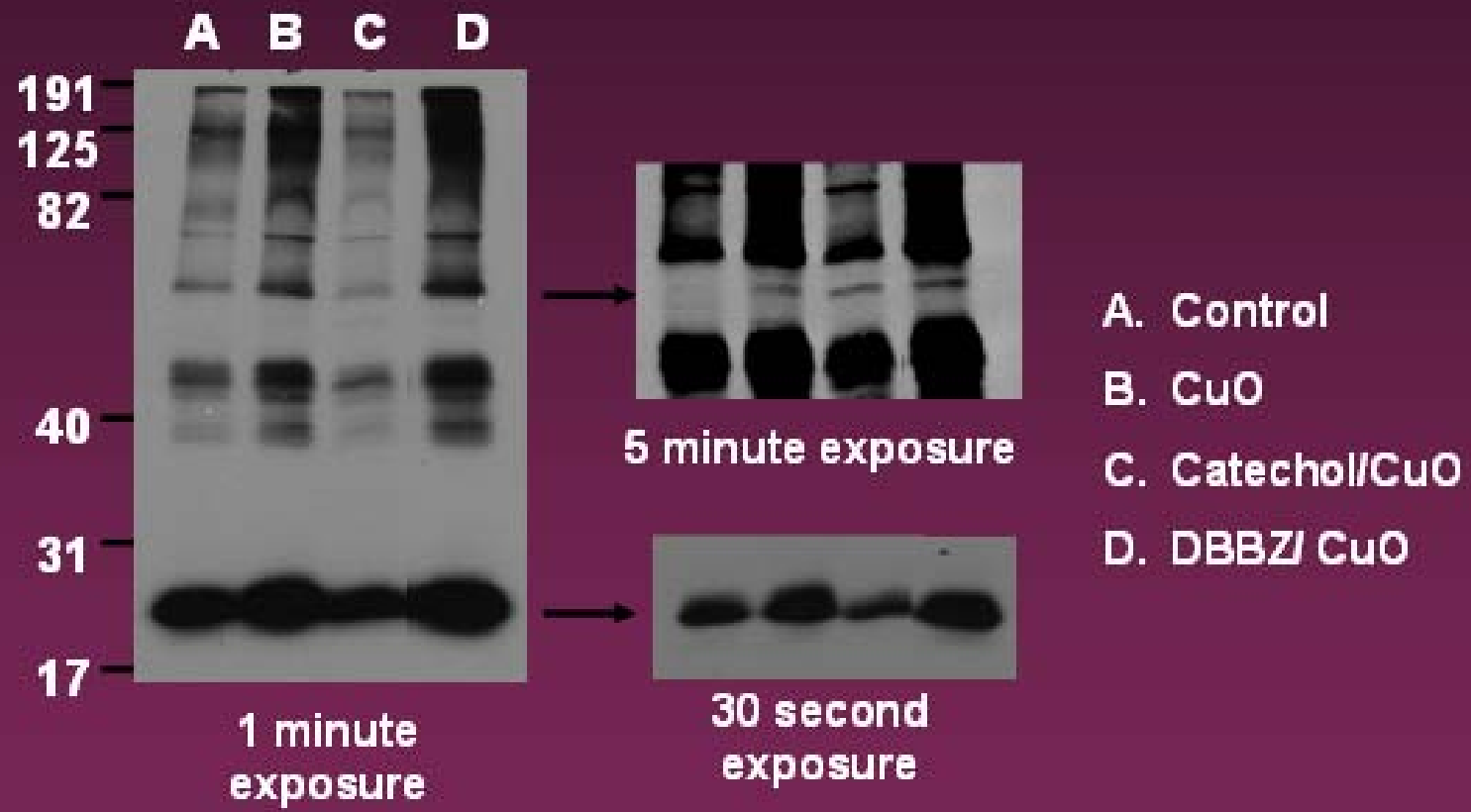
Radical/Particle Systems Suppress P450 in the Lung



Radical/Particle Systems Increase Free Radical Damage

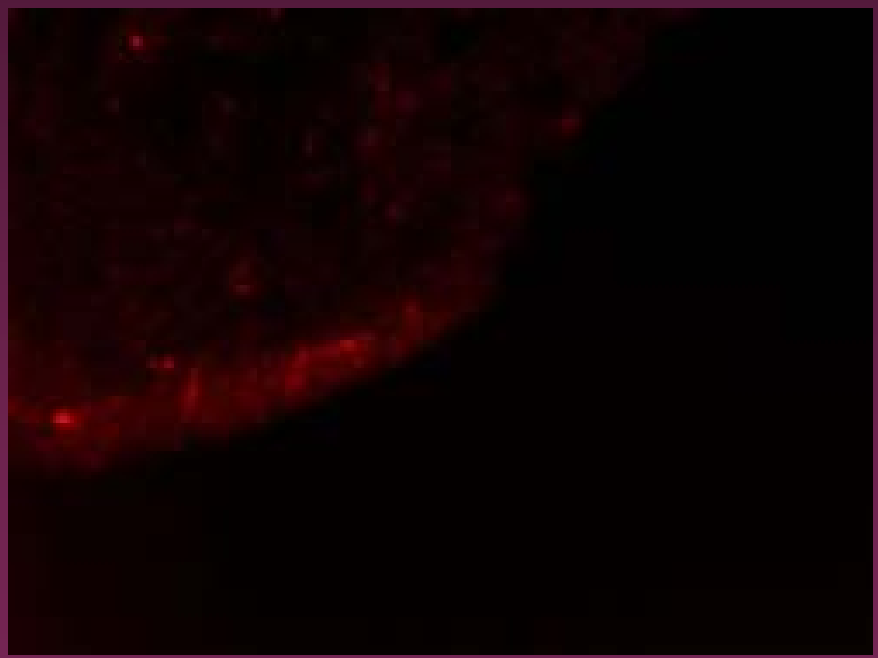


Myocardial $ONNO^{\cdot -}$ is Evidence of Increased Oxidative Stress to Heart Tissue

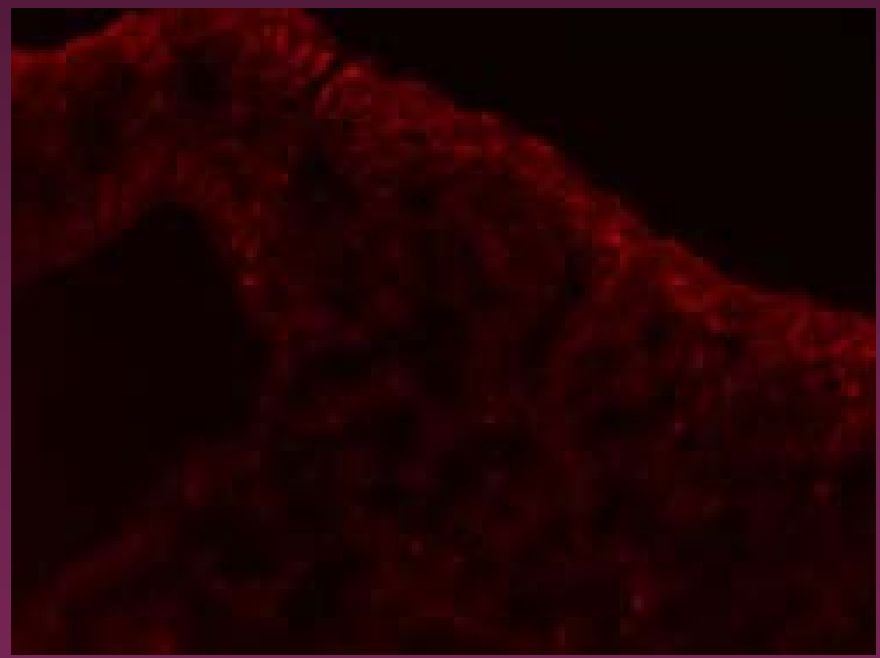


Increase in ROS in Heart Tissue by DHE Staining

Control



Catechol/CuO



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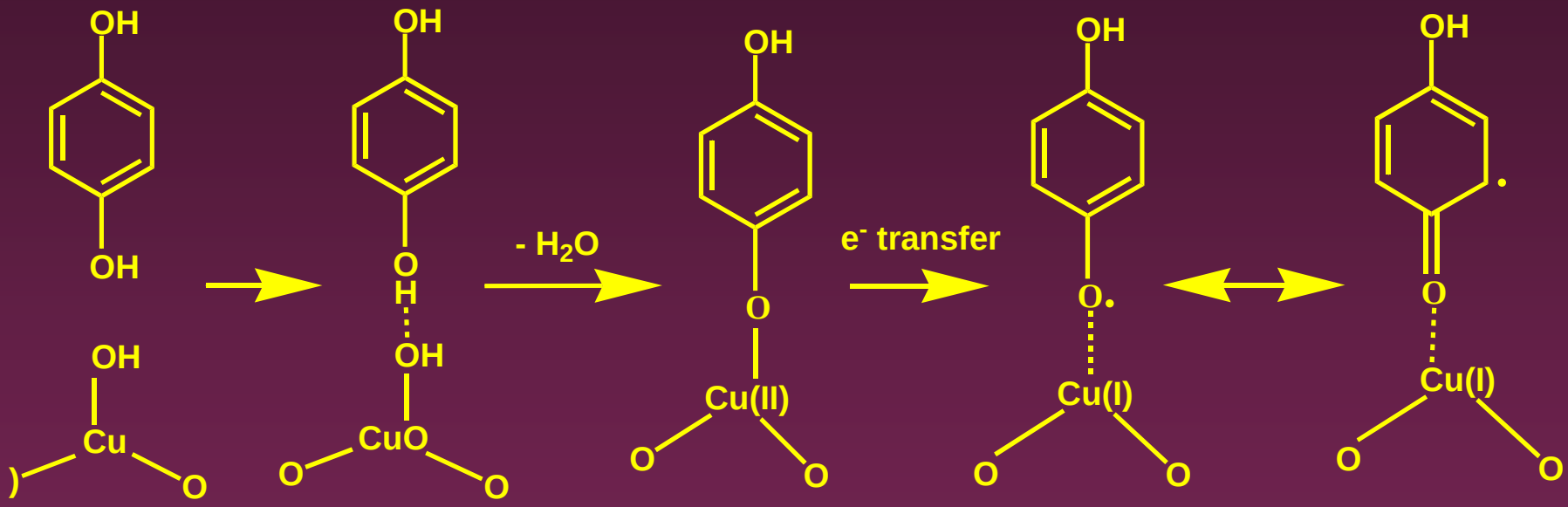
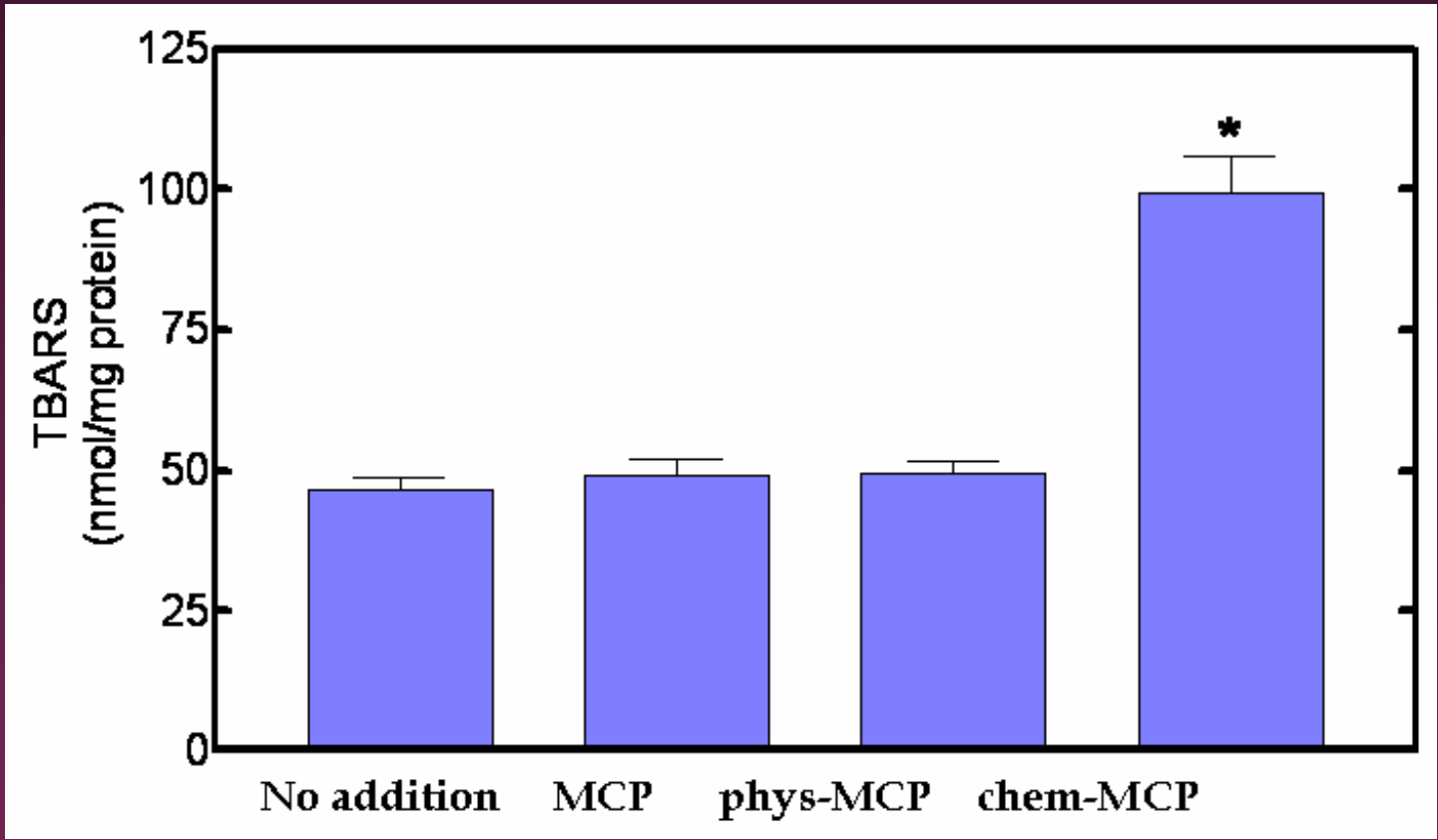
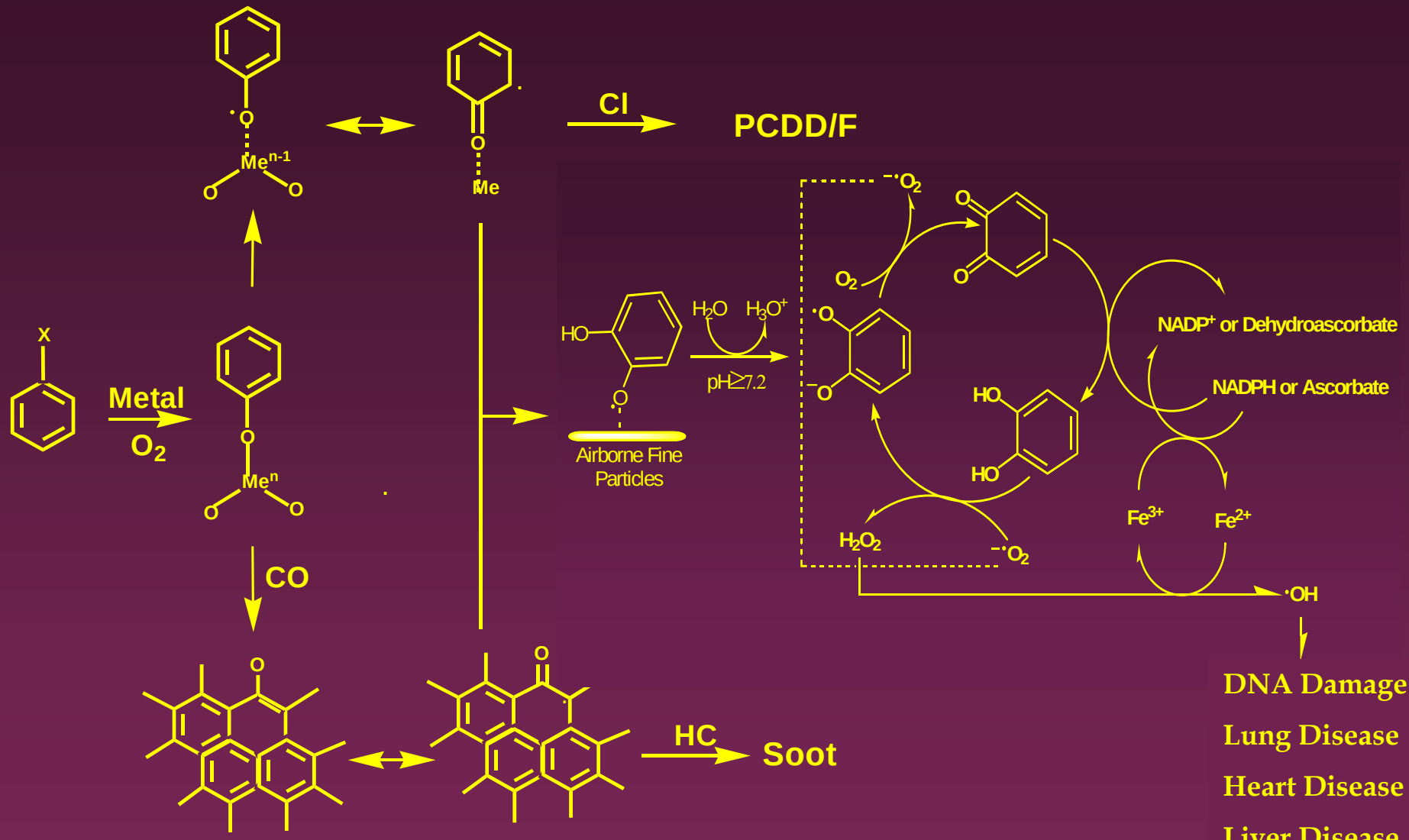


Only Chemisorbed Chlorophenol Increases Lipid Peroxidation

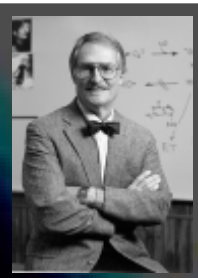



Cl
PCDD/F
Metal
O_2
CO
HC
Soot
Airborne Fine Particles
H_2O H_3O^+
pH≥7.2
NADP+ or Dehydroascorbate
NADPH or Ascorbate
Fe^{3+}
Fe^{2+}
H_2O_2
·OH
DNA Damage
Lung Disease
Heart Disease
Liver Disease

Julien Adunkpe

Steven Alderman

Robin McCarley



Bill Pryor

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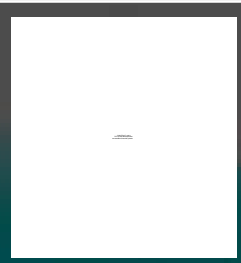
Wayne Backes

Randy Hall

Cheri McFerrin

Hieu Truong



Mikhail Bryukov

Steph Cormier

Lavri Khachatryan

Sofia Masko

Kurt Varner

Shadrack Ndyaie

Catherine Evans

Slawo Lomnicki

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Judy Wornat

Rafael Cueto
Andy Deutsch
Guis Squadrito