

## Secondary Organic Aerosol Produced from Aqueous Reactions of Phenols

JEREMY D. SMITH<sup>1</sup>, LU YU<sup>2</sup>, KATHRYN GEORGE<sup>3</sup>,  
HALEY KINNEY<sup>1</sup>, ANN M. DILLNER<sup>3</sup>, QI ZHANG<sup>2</sup>  
AND CORT ANASTASIO<sup>1</sup>

<sup>1</sup>Department of Land, Air, and Water Resources, University of California-Davis

<sup>2</sup>Department of Environmental Toxicology, University of California-Davis

<sup>3</sup>Crocker Nuclear Laboratory, University of California - Davis

The formation and evolution of secondary organic aerosol (SOA) in atmospheric condensed phases (i.e., aqueous SOA) can proceed rapidly; however, relatively little is known of the important aqueous SOA precursors or their reaction pathways. In our work we are studying the aqueous SOA formed from reactions of phenols, (phenol, guaiacol, syringol), benzene-diols (catechol, resorcinol, hydroquinone), and phenolic carbonyls (e.g. vanillin, syringaldehyde). These species are good aqueous SOA precursors because they are released in large quantities from biomass burning, are highly water soluble, and are easily oxidized.

The goal of our current work is to experimentally determine the rate constants for degradation and mass yields of SOA formation from the oxidation of the phenols via direct photodegradation, hydroxyl radical ( $\cdot\text{OH}$ ) oxidation, and reaction with an excited organic triplet state. We use 3,4-dimethoxybenzaldehyde (DMB) as our triplet excited state organic precursor as it is released in high quantities from biomass burning, has significant solar light absorption and is very water soluble. Our measurements of the reactions of phenols, benzene-diols and phenolic carbonyls show that all three classes make aqueous SOA with mass yields near 100% though with a wide range of kinetic reactivities. Furthermore, analysis of the products with FTIR, AMS and UV-Vis spectrometry show that aqueous reactions with phenolics form carbonyl functional groups as well as dimers and higher oligomers that absorb strongly in the solar spectrum. Using our results in a simple model shows that aqueous oxidation of phenolics through triplet excited states can be much faster than via  $\cdot\text{OH}$ , and that aqueous reactions of phenols in areas impacted by biomass combustion can be a major source of SOA.