

Design of Carbons for Catalytic Destruction of Methyl Bromide by Reduced Sulfur Species

William Mitch, Department of Chemical and Environmental Engineering, Yale University

The research is evaluating catalytic destruction of methyl bromide sorbed to black carbons (e.g., activated carbon) by reduced sulfur species (e.g., thiosulfate or hydrogen sulfide). The keys to improving the catalytic destruction process are to understand the operative reaction pathway, and the characteristics of the carbon that promote these reaction pathways. Reduced sulfur species are potent reductants and nucleophiles, both of which pathways can apply to methyl bromide. The researchers developed an electrochemical cell to differentiate reductive destruction from nucleophilic substitutions. Previous literature on black carbon-mediated reactions highlights the potential importance of oxygenated functional groups in mediating destruction reactions. Surface characterization of black carbons is notoriously difficult. The research is pursuing an alternative pathway whereby aromatic compounds with known functional groups (e.g., anthracene with a quinone functionality) are sorbed to sheet graphite; graphite serves as a base case for black carbon with minimal native oxygenated functional groups. This method has the advantage of enabling more controlled modifications of the surface coverage of black carbon than traditional methods (e.g., ozonation). The Mitch group is beginning the evaluation of the influence of functional group variety and surface percentage coverage using model contaminants representing compounds whose carbon-mediated destruction proceed by nucleophilic substitution and reduction. Carbons planned for use in methyl bromide capture could then be treated to promote the prevalence of functional groups that promote destruction.