

## **Designing Polymeric Hydrocarbons for Low Flammability Materials**

*Todd Emrick, Liz Stubbs, Chien-Han Chen, and Krishna Murthy  
Polymer Science & Engineering Department, University of Massachusetts, Amherst, MA 01003  
Email: tsemrick@mail.pse.umass.edu*

The persistent problem of materials flammability associated with organic polymers presents an ongoing challenge of designing polymers that have both useful materials properties *and* which limit the concerns associated with polymer flammability and additives toxicity. Along these lines, this presentation will highlight recent progress at UMass Amherst in which oligomeric and polymeric compounds, despite lacking any halogenated or phosphorus-based components, exhibit exceptionally low heat release properties (evaluated by microscale calorimetric measurements) and non-flammability (as judged by vertical burn tests). Aromatic polymers built from deoxybenzoin and related structures will be described, focusing especially on 1) network formation techniques in which multifunctional monomers are integrated into crosslinked components *via* two-stage, orthogonal reactive chemistries and 2) step-growth polymerization chemistry to give linear and branched polymers that may be employed as stand-alone materials or as flame-retardant additives to conventional commodity polymers. In some cases, calorimetric measurements show fire growth capacity (FGC) values of these structures to be <100 J/g-K, while several versions are readily integrated into reactive processing methods with other polymer structures. Overall, the presentation will describe the roles of materials synthesis, properties evaluation, and flammability characterization methods as instructive tools for evaluating future possibilities for improved, non-flammable materials for aircraft.