Abstract for Fire Research Sessions - 9th International Aircraft Fire and Cabin Safety Research Conference:

Session: **Fire Research III – Advanced Materials**

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Abstract:

There are now several aircraft flying commercially which use epoxy + carbon fiber composites as structural and non-structural materials for light weight benefits that enable reduced fuel consumption and extended flight range. These materials pass burn-through tests via additional assemblies inside the fuselage which add complexity to aircraft assembly and maintenance. If the base epoxy used in these composites could be flame retarded further with reactive flame retardants, some of these fire protection blankets and sub-assemblies may not longer be needed.

For structural composites for vehicles and aircraft, new chemistries which enhance char formation and reduce heat release, but are compatible with existing epoxy chemistry, are required. Phosphorus based flame retardants for epoxies have been well studied to date, as well as some phosphorus-nitrogen compounds, but phosphorus hydrazides have not been studied for their flame-retardant potential in epoxy. These hydrazides bring some novel synthetic structures to phosphorus flame retardant chemistry and may also release nitrogen during combustion to further help reduce heat release during fires. Recent work at the University of Dayton Center for Flame Retardant Material Science has been studying the use of phosphorus hydrazides as flame retardants for epoxy, and has found some promising initial results that suggest these flame retardants merit further study. In this paper, we will present work on an aerospace grade Bisphenol F based epoxy (Epon 862) that was combined with an aliphatic amine cure agent (Epikure 3274) and various phosphorus-hydrazide flame retardants at 2.5 mol% phosphorus loading levels. These materials were studied for heat release reduction potential by micro combustion calorimetry (ASTM D7309). The testing showed that three of hydrazides showed good reductions in heat release while simultaneously increasing char yield. Scale-up of these chemicals was then accomplished, with mixed success, to yield materials that were studied with larger scale heat release testing via cone calorimeter (ASTM E1354) to show how the flame retardants affected heat release, smoke release, and effective heats of combustion. Data collected in regard to the mechanism of flame retardancy for these new materials will also be discussed, and the data suggests that these materials, depending upon their chemical structure, show both vapor and gas phase flame retardant effects in epoxy.