Investigation of a Novel, Endothermic, Inorganic Fiber to Improve the High Temperature Performance of Fire-Resistant Protective Apparel

Cofer, Savannah

Vallabhaneni, Varun

The tragic deaths of 19 Arizona firefighters in 2013 reminds us that firefighters are regularly exposed to extreme temperatures and hazardous conditions. Current protective apparel, however, rapidly degrades at temperatures above 300°C, which is common during dangerous flashover conditions. Our investigation sought to develop an alternative material based on a high temperature endothermic fiber that would provide superior resistance at elevated temperatures, while meeting the requirements of fire-resistant protective apparel. We used several analytical methods to evaluate our high temperature materials and discovered that a new class of alumina-silica hydrate fibers were extremely effective in extending the useful temperature range as compared to aramid fibers, which have been the industry standard for the past 30 years. In fact, the alumina-silica hydrate fibers demonstrated significantly greater stability without degradation at temperatures over 1,000°C. Our high temperature tests have furthermore shown that the alumina-silica hydrate fibers exhibit an increase in strength as the fibers undergo a condensation reaction to form an amorphous alumina-silica fiber, providing highly durable insulation at elevated temperatures. These superior properties demonstrate that alumina-silica hydrate fibers have the potential to dramatically improve the high temperature effectiveness of fire-resistant protective apparel.

Awards Won: