Nanocomposite Coating for Flame Resistant Cotton Fabric

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Cotton fabric was treated with flame-retardant coatings composed of branched polyethylenimine (BPEI) and sodium montmorillonite (MMT) clay, prepared via layer-by-layer (LbL) assembly. Four coating recipes were created by exposing fabric to aqueous solutions of BPEI (pH 7 or 10) and MMT (0.2 or 1 wt. %). BPEI pH 10 produces the thickest films, while 1 wt. % MMT gives the highest clay loading at 87 wt. % in the films. Each coating recipe was evaluated at 5 and 20 bilayers. Thermogravimetric analysis showed that coated fabrics left as much as 13 % char after heating to 500 °C, nearly two orders of magnitude more than uncoated fabric, with less than 4 wt. % coming from the coating itself. These coatings also reduced afterglow time in vertical flame tests. Post-burn residues of coated fabrics were examined with SEM and revealed that the weave structure and fiber shape in all coated fabrics were preserved. The BPEI pH 7/1 wt. % MMT recipe was most effective. Microcombustion calorimeter testing showed that all coated fabrics reduced the total heat release and heat release capacity of the fabric. Fiber count and strength of uncoated and coated fabric are similar. These results demonstrate that LbL assembly is a relatively simple method for imparting flame-retardant behavior to cotton fabric. This work lays the foundation for using these types of thin film assemblies to make a variety of complex substrates (foam, fabrics, etc.) flame resistant and has already been shown to eliminate melt dripping in open-celled polyurethane foam.

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