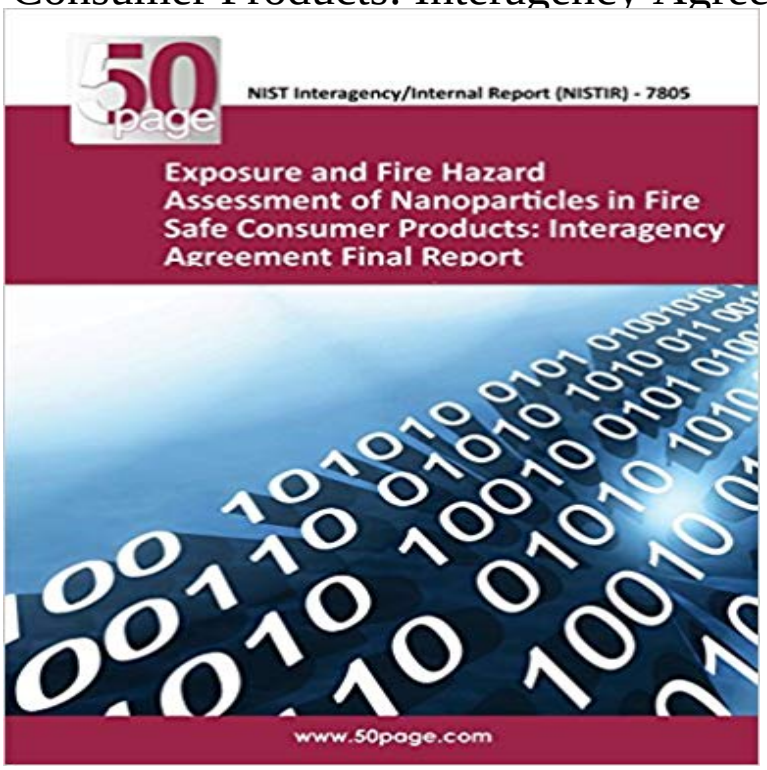
Exposure and Fire Hazard Assessment of Nanoparticles in Fire Safe Consumer Products: Interagency Agreement Final Report



An innovative technology was evaluated to generate fire and health safe soft furnishings. Nanoparticle-based thin coatings on a polyurethane foam and nonwoven barrier fabric were applied using Layerby- layer (Lbl) assembly. This is the first report of using Lbl on a complex three dimensional substrate, to improve the fire resistance of foam and barrier fabrics, and with sodium montmorillonite clay (MMT), carbon nanofibers (CNF) and multi-walled carbon nanotubes (MWCNT). The Lbl process was tailored for each nanoparticle in order to fabricate durable coatings that completely covered the entire substrate surface. The CNF and MWCNT coatings on foam were thinner and contained fewer nanoparticles, but resulted in the greatest reduction in peak heat release rate (flammability). The reduction in foam flammability due to the nanoparticle //Lbl coatings is as high as 1138% greater than 17 other commercial fire retardants commonly used in foam. This technology has strong commercial viability for foam due to easy and flexibility of the Lbl process and the significant reduction in foam flammability caused by the coatings. However, Lbl does not work for nonwoven barrier fabrics as the structure was unable to remain intact during the fabrication process. In order to enable other agencies to access the potential health risk of using this nanoparticle-based technology for reducing the flammability of soft consumer products, this project developed the methodology to promote, collect, and quantify nanoparticles released from these substrates. In general, the release of nanoparticles was an order of magnitude higher from simulated chewing than simulated wear and tear, highest from the barrier fabric, and lowest for MMT. The release was between 0.50 mass fraction % to 0.0003 mass fraction % of the total nanoparticle loading on the substrate.

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