New NIST roadmap charts path to reduced fire hazards from materials

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NIST firefighters Justin Grossnickle and Martin Neal look over the end of a controlled test to study the impact of fire on cross-laminated timber buildings. CLT is a construction material identified in a new NIST report as needing more flammability research. Credit: NIST

Fire researchers will tell you that there's a simple solution for reducing

fire hazards: eliminate flammable materials. If it doesn't burn, the experts say, then there won't be a fire. Of course, that option isn't very practical or realistic; after all, who wants to sit on a block of cement when you can have a cushiony recliner?

A better strategy for reducing the thousands of deaths and injuries and billions of dollars in damage resulting from the more than a million fires each year in the United States is detailed in a new research roadmap published by the National Institute of Standards and Technology (NIST). The roadmap provides guidelines for developing science-based approaches to solving numerous fire problems for multiple materials, from lightweight automobile composites to cross-laminated timbers, and prioritizes the most critical and urgent fire hazards to which they can be applied, such as upholstered furniture.

"Our hope is that this roadmap will help the global fire community develop research strategies and implementation plans for addressing fire and materials problems, now and in the future," said NIST materials research engineer Rick Davis, one of the authors. "The roadmap identifies and describes the major challenges associated with these problems and then details potential solutions so that users such as designers and manufacturers can continue to create safer materials that still yield quality products with high consumer satisfaction and market profitability."

The research roadmap resulted from a recent NIST-led workshop that brought together key national and international stakeholders from industry, government, academia and public laboratories.

Workshop attendees focused their discussions on four areas in which fire hazards are major concerns: innovative construction materials such as the growing use of cross-laminated wood for tall buildings; advanced polymers and composites such as polyester fabrics used in furniture and

lightweight composites used in automobile bodies; next-generation fire retardants, with an emphasis on those that suppress combustion without being health hazards; and transportation and infrastructure vulnerabilities such as fire risks on trains.

For each of these areas, the experts considered the direction of current R&D and how it may impact future fire hazard reduction goals such as developing new materials, establishing product flammability standards and advancing computational tools. They also addressed emerging technologies and practices such as the increasing use of high-energy density (lithium-ion) batteries that have been in the news for flammability concerns.

The workshop participants agreed that the highest priority for future scientific studies and development projects in flammability should go to cross-cutting research approaches that can work against multiple hazards across a wide range of materials and applications. These are:

- Real fire behaviors: To understand how the actual use of a product impacts its fire service-life (the fire resistance over the life of a product) and burning behavior;
- Engineered fire-safe products: To enable the development of technologies that yield products compliant with flammability regulations for their entire lifetime; and
- Bench-scale and computational tools: To develop and use physical testing methods and computer modeling systems that accurately predict a material's real-life fire behavior.

The new roadmap strongly recommends that these research approaches be applied to the five most critical and urgent fire hazards as defined by the experts at the recent workshop. These are: residential upholstered furniture, residential buildings in Wildland Urban Interface (WUI) communities, timber used for multistory buildings, passenger railway

cars and insulation applied to the exteriors of high-rise buildings.

"The workshop participants determined that these application areas should be prioritized for R&D because reducing flammability in all five should significantly reduce the overall losses from fires in the future," Davis said.

The benefits from the new research roadmap, Davis said, could eventually be greater than just getting low-fire-hazard products to market. "It's our hope that the research resulting from the roadmap will lead to science-based quality control measures, testing procedures and performance standards for materials flammability, which in turn, should reduce the costs of making products, simplify regulatory compliance for manufacturers, and provide consumers with more fire-safe product choices," he explained.

Davis added that along with being actively engaged with its partners to promote and urge acceptance and use of the new roadmap by others, NIST has already begun putting it to work.

"Based on extensive discussions with our in-house experts after considering the roadmap's guidelines, we are planning changes in our upcoming year's research and modifying our long-term strategies," he said.

More information: Rick Davis et al, Workshop report: research roadmap for reducing the fire hazard of materials in the future, (2018). DOI: 10.6028/NIST.SP.1220

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