# UMass Amherst Scientists Create Fire-Safe Plastic

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Scientists from the University of Massachusetts Amherst have created a synthetic polymer—a building block of plastics—that doesn't burn, making it an attractive alternative to traditional plastics, many of which are so flammable they are sometimes referred to as "solid gasoline."

The new polymer wouldn't need the flame-retardant chemicals that are added to many plastics before they can be used in bus seats, airplanes, textiles and countless household items. Some of these additives have been showing up in dust in homes and offices, fish, fat cells and breast milk, raising concern that they pose a risk to human health and the environment. (Last month the state of Washington banned a class of flame-retardants from use in household items from mattresses to computers—the first state to do so.)

Led by UMass Amherst scientists Richard Farris, Bryan Coughlin and Todd Emrick, the research team will present an update on their work to industry representatives and scientists from the Federal Aviation Administration (FAA), the National Institute of Standards and Technology and the U.S. Army on May 14. The team described the new polymer in the journal Macromolecules last year.

According to the FAA, 40 percent of passengers who survive the impact of an airplane accident die in the fire that follows. The agency requires that aircraft use the most flame-resistant plastics that are available, but "we're shooting for a fire-proof cabin," says Richard Lyon, manager of the FAA's fire research program. "To get there we have to invent plastics

that don't yet exist—plastics that don't burn, or burn so slowly that there is ample time for passengers to escape from an aircraft fire," he says.

When something burns, it decomposes thermally; some of it becomes a gas—that's what burns as flame—and what doesn't burn becomes what polymer scientists refer to as "char"—that's the solid that is left behind. The goal when creating flame-resistant plastics is to have a very high char yield—more char means less fire and fewer volatile chemicals being released. Most common plastics burn readily (polypropylene has a char yield of zero), so fire-retardant additives are mixed in—these often are halogenated molecules that contain reactive chemicals such as chlorine, bromine or phosphorous. These additives have been particularly effective at reducing the flammability of plastics, but have come under increased scrutiny for being potentially damaging to human health and the environment.

The polymer that the UMass Amherst team synthesized has a naturally high char yield (70 percent) and doesn't contain any halogens. It uses bishydroxydeoxybenzoin or BHDB as a building block, which releases water vapor when it breaks down in a fire, rather than hazardous gasses. The synthetic polymer seems to have all the desired qualities of a flame resistant plastic: it is clear, flexible, durable and much cheaper to make than the high-temperature and heat-resistant plastics in current use, which tend to be brittle and dark in color.

"The great thing about BHDB is that it's really a two-birds-with-one-stone approach for a new polymer," says Coughlin. "It is extremely fire-safe, and does not contain halogenated additives, which are known to be environmentally hazardous."

"This is an environmentally friendly solution with a lot of economic potential," says the FAA's Lyon. UMass Amherst's department of polymer science and engineering has a long-standing partnership with the

FAA's fire-safety branch.

The next step, say the researchers, is to make a couple of tons of BHDB—enough to make aircraft parts and do more tests. Eventually it may end up in combat gear for soldiers, in circuit boards, bus seats and numerous household products.

"We had to work outside the usual chemistry routes one takes to make something non-flammable," says UMass Amherst's Emrick. "It was a challenge, but once we realized BHDB was a useful building block, the synthetic polymer chemistry fell into place."

Source: University of Massachusetts