A new way to recycle polycarbonates that prevents BPA leaching

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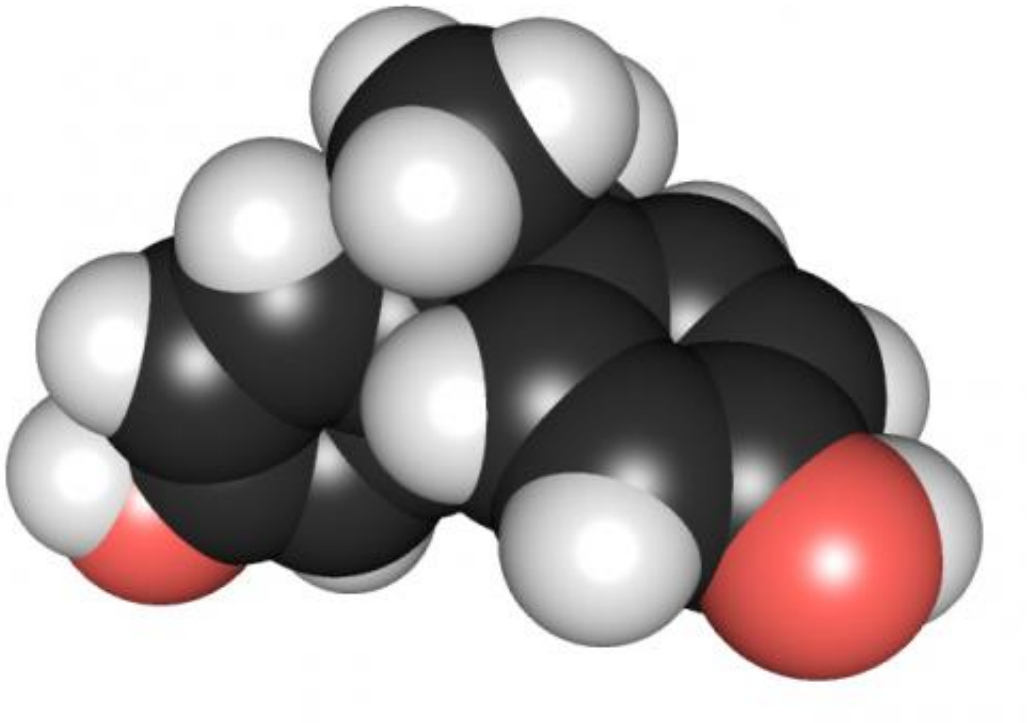

3D chemical structure of bisphenol A. Credit: Edgar181 via Wikimedia Commons

(Phys.org)—A team of researchers at IBM's Research facility in Almaden, San Jose (the same site where Watson was developed) has developed a one-step process for recycling polycarbonates into another type of plastic—one that does not release bisphenol A (BPA) into the

environment when it is used or dumped into a landfill. They have published a paper describing their new technique in *Proceedings of the National Academy of Sciences*.

Most people would not think of IBM as a place for chemists working with plastics, but the Almaden facility was designed to conduct research into a wide variety of applications, ranging from food safety, to medical imaging, nanomedicine, services science and atomic scale storage. Solving the problem of an ever building supply of polycarbonate waste actually fits well with IBM's research efforts because so many of the company's products use it as a base component.

Polycarbonates are a hard type of plastic, they are used to make CDs, DVDs, phone screens and a host of other hard plastic products, and as the researchers note, the material is extremely popular—approximately 2.7 million tons of it is produced annually around the world. But unlike soda bottles, polycarbonates are not easily recycled for reuse which means they generally wind up in landfills and dumps. Also they are a type of plastic that release small amounts of BPA when used and large amounts as they break down, allowing the chemical to leach into landfills, very likely leading to massive problems in the future. In this new effort, the team at IBM has found a way to convert polycarbonate material into another type of plastic called polyaryl ether sulfone (PSU) that can be used in applications such as medical equipment, fiber optics and purifying water.

The process involves heating the plastic along with carbonate salts (akin to baking powder) and a fluoride reactant, which causes a cascading reaction to occur—first decomposing the material into a monomer and then condensing the result to a PSU. The resulting plastic is harder than typical polycarbonates, which makes it ideal for other applications and easier on the environment because it will not leach BPA into the ground once it makes its way to a landfill.

More information: Computational and experimental investigations of one-step conversion of poly(carbonate)s into value-added poly(aryl ether sulfone)s, *PNAS*, www.pnas.org/cgi/doi/10.1073/pnas.1600924113

Abstract

It is estimated that ~2.7 million tons poly(carbonate)s (PCs) are produced annually worldwide. In 2008, retailers pulled products from store shelves after reports of bisphenol A (BPA) leaching from baby bottles, reusable drink bottles, and other retail products. Since PCs are not typically recycled, a need for the repurposing of the PC waste has arisen. We report the one-step synthesis of poly(aryl ether sulfone)s (PSUs) from the depolymerization of PCs and in situ polycondensation with bis(aryl fluorides) in the presence of carbonate salts. PSUs are high-performance engineering thermoplastics that are commonly used for reverse osmosis and water purification membranes, medical equipment, as well as high temperature applications. PSUs generated through this cascade approach were isolated in high purity and yield with the expected thermal properties and represent a procedure for direct conversion of one class of polymer to another in a single step. Computational investigations performed with density functional theory predict that the carbonate salt plays two important catalytic roles in this reaction: it decomposes the PCs by nucleophilic attack, and in the subsequent polyether formation process, it promotes the reaction of phenolate dimers formed in situ with the aryl fluorides present. We envision repurposing poly(BPA carbonate) for the production of value-added polymers.