New metallic bubble wrap offers big benefits over other protective materials

July 8 2013, by Matt Shipman

Researchers at North Carolina State University have developed a new metallic bubble wrap that is lighter, stronger and more flexible than sheet metal and more heat- and chemical-resistant than plastic or other polymer-based bubble wraps. Credit: Afsaneh Rabiei

Researchers at North Carolina State University have developed a new metallic bubble wrap that is lighter, stronger and more flexible than sheet metal and more heat- and chemical-resistant than plastic or other polymer-based bubble wraps. Potential applications include automobile body panels, the wing edges of airplanes, suitcases, helmets and cases for computers and other electronic devices.

"This material does exactly what sheet metal and other bubble wraps do, but better," said Dr. Afsaneh Rabiei, professor of mechanical and aerospace engineering and the lead researcher on the project. "And it won't cost businesses and consumers very much because producing it requires just a few steps."

Rabiei developed the metallic bubble wrap to offer protection in areas that are only a few millimeters thick. To be effective, such materials must be thin enough to fit inside tightly spaced product linings, flexible enough to withstand twisting and bending, and strong enough to protect the contents inside.

To create the bubble wrap, Rabiei started with a thin sheet of aluminum and used a studded roller to dot the material with small indentations. Then she deposited a foaming agent—such as calcium carbonate or titanium hydrate—into the indentations. When heated, such agents decompose and create bubbles.

Rabiei covered the aluminum with another sheet, sandwiching the foaming agent in its indentation troughs. She ran a heavy roller over the two sheets to bond them together. In the final step, she placed the combined sheet into a furnace, where the heat broke down the foaming agent and created air bubbles in the material. The process is akin to baking soda causing batter to rise when baking a cake.

The researchers applied a variety of mechanical tests to the metallic bubble wrap to evaluate its properties and compare it with the original bulk sheet metal. The bubble wrap, which weighs about 20 to 30 percent less than the bulk material, offered a 30 to 50 percent increase in bending strength. The tensile strength—essentially the material's breaking point—was nearly identical to the non-bubbled metal.

"The way we created this material could be used for any sheet metal, not

just aluminum," Rabiei said. "We plan to further develop our metallic bubble wrap and hope it eventually offers better protection for products and the public."

Rabiei announced the creation of the bubble wrap June 24 at the 8th International Conference on Porous Metals and Metallic Foams in Raleigh, N.C. A paper on the invention is forthcoming in the conference's proceedings.

Rabiei's keynote presentation, including the metallic bubble wrap and its method of processing, was picked as one of the technical highlights of the conference by the audience. A poster presentation on the topic received the first place poster award.

More information: "Introduction of a New Type of Metal Foam (Metallic Bubble Wrap)" Di Miao and Afsaneh Rabiei, North Carolina State University. Presented: June 24 at the 8th International Conference on Porous Metals and Metallic Foams in Raleigh, N.C.

Abstract: New type of metallic foam is processed in the form of thin sheet metals with longer lifetime and more reliable properties than currently used sheet materials. The current closed cell metallic foams are highly porous and non-uniform and their deformation behavior is not predictable, particularly in a thin sheet form. The new material has combined rolling processing technique with careful placement of foaming agent to produce thin sheet metal foams (a metallic version of bubble wraps) with regular pore structure and possibility of further addition of reinforcement. Design and manufacturing of the processing tools, processing of metallic bubble wrap sheets and full evaluation of the mechanical, micro-structural and physical properties of the processed material are reported in this study.

Provided by North Carolina State University