“For Your Protection, a New Kind of Metal” Excerpt Transcript

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IRA FLATOW	This is Science Friday. I'm Ira Flatow. Up next, metal foam. That's what I said. Think of a porous material, like Styrofoam, but made out of steel, aluminum, or another metal. We have a great video on our website of ballistic tests showing this material shattering an armor-piercing bullet shot at it. It's amazing, it just—boom—goes away. But metal foam has promises way beyond military applications. Here with details on this new space-age material, as we used to like to say, is Afsaneh Rabiei. And she is Professor of Mechanical and Aerospace Engineering at North Carolina State University in Raleigh. Welcome to Science Friday.
AFSANEH RABIEI	Thank you very much.
FLATOW	Let's, let’s start with the video of a bullet striking this metal foam. Describe what's happening there.
RABIEI	Well, we have a composite armor made out of our material, with some front plate and back plate. And we do ballistic testing, all sorts of different impacts from type three, type four—which is the different sizes of bullet—and then 50 cal [caliber]. And we were happily surprised to see that even the hard core of the bullet is stuck in those bubbles that we have created inside the metal. I originally started making this material, not necessarily for armors, but more for cars and trains, to squeeze like a sponge, but in a heavy-duty kind of a form of a sponge. So we can put it in front of a car or high-speed train and take care of the collision impact. But when we saw the performance of the material, we started thinking, how about ballistics and bullet? So I tested those, and you saw what you saw. [You] saw that the material can perform. Basically, what we have here is a bunch of air bubbles that are embedded in a material. And when you hit that material, it will squeeze the bubbles. And by squeezing the bubbles, it will absorb the energy.

FLATOW	It's sort of counterintuitive to think that you're adding a lot of bubbles to the metal that would make it stronger. Is there any secret to how you arrange the bubbles inside that make it better?
RABIEI	Well, actually, that is the main purpose. Because I'm not the first person who ever made metal foam. There have been other studies where people blow air into a molten metal and create a metal foam, similar to a bubble bath. The problem with other metal foam has been—it creates a bunch of bubbles—we call it porosities or air pockets—that are in different sizes. They are randomly connected, and there is no structure to hold those bubbles. But our material has a very uniform bubble structure. So the load or the force is uniformly distributed between all of those porosities. At the same time, we added some matrix to hold those bubbles together to work in force-bearing. As a result, the material has become the strongest metal foam, and it can perform well in low-temp or high-temp.
FLATOW	And not only—I understand that it also can work to be resistant to radiation in spacecraft. Would it block radiation coming in?
RABIEI	Correct. It can block the radiation—not only radiation, but also heat. And the reason for that is the air that is trapped inside those porosities that provide a scattering of the radiation, as well as providing a kind of heat shield. It's very similar to all those porosities inside the Styrofoam. And it's similar, but in a metal form.
FLATOW	Sort of a Styrofoam metal. I want to thank you very much for taking time to be with us, Afsaneh.
RABIEI	Thank you for having me.
FLATOW	Afsaneh Rabiei is Professor of Mechanical and Aerospace Engineering at North Carolina State University right there in Raleigh.