MATERIALS SCIENCE

A LIMBER FUTURE

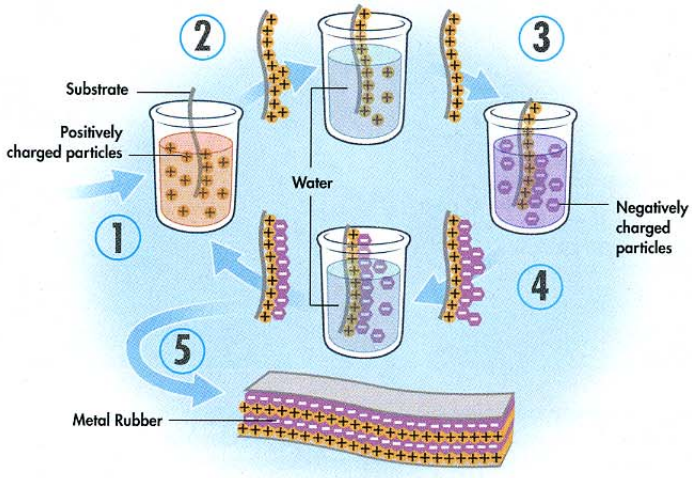
"Smart skin" holds promise for morphing wings and wearable computers.

Terrible, horrible things can be done to this millimeters-thick patch of shimmering material crafted by chemists at NanoSonic in Blacksburg, Virginia. Twist it, stretch it double, fry it to 200°C, douse it with jet fuel—the stuff survives. After the torment, it snaps like rubber back to its original shape, all the while conducting electricity like solid metal. "Any other material would lose its conductivity," says Jennifer Hoyt Lalli, NanoSonic's director of nanocomposites.

The abused substance is called Metal Rubber, and, according to NanoSonic, its particular properties make it unique in the world of material chemistry. As a result, the company's small office has been flooded with calls from Fortune 500 companies and government agencies eager to test Metal Rubber's use in everything from artificial muscles to smart clothes to shape-shifting airplane wings.

At this stage, however, NanoSonic is busy meeting the demand for its 12-inch-by-12-inch samples, which take custom-built robots up to three days to create. That's speedy, if you consider that Metal Rubber, a product of nanotechnology, must be fabricated molecule by molecule.

DESPITE THE NAME, METAL RUBBER, ABOVE, "CONTAINS JUST PARTS PER MILLION OF METAL YET CONDUCTS ELECTRICITY NEARLY AS WELL AS A SOLID METAL," SAYS POLYMER CHEMIST JENNIFER HOYT LALLI (LEFT). ITS SECRET? CHEMICAL BONDS THAT STRETCH APART BUT DON'T BREAK.



MAKING METAL RUBBER FROM SCRATCH
Dip charged substrate into container of positively charged water-based solution (1). Rinse substrate in water to remove unbound particles (2). Dip substrate into negatively charged solution (3). Rinse and repeat (4, 5).

The manufacturing process, called electrostatic self-assembly, starts with two buckets of water-based solutions—one filled with positively charged metallic ions, the other with oppositely charged elastic polymers. The robot dips a charged substrate (glass, for example) alternately from one bucket to the next. The dipping slowly builds up tight, organized layers of molecules, bonded firmly by opposing charges. Afterward the substrate is removed, leaving a freestanding sheet of Metal Rubber.

With investor interest booming, Metal Rubber could make its commercial debut within a year or so. Although shape-shifting aircraft wings and sensory robotic gloves are on the horizon, Metal Rubber will probably appear first in more humble, practical roles. Abuse-resistant flexible circuits and wires, for instance, could allow you to do terrible, horrible things to your portable electronics—consequence-free.

—LAURA ALLEN

A RETURN TO THE SHIPWRECK TO ASSESS ITS CONDITION. /// 06.19.04 OZONE EYES NASA IS EXPECTED TO LAUNCH AURA, THE THIRD IN A TRIO OF EARTH OBSERVING SATELLITES, >