Smart materials for high-tech products

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Researchers are testing oscillation-damping piezo bearings aboard a VW Passat. Credit: Fraunhofer LBF

Flexible and independently operating "smart materials" can adapt to changing conditions with high speed. The Fraunhofer Adaptronics Alliance is presenting promising solutions at Hannover Messe (April 4-8), in Hall 2, Stand D18.

The droning of a car driving along the highway can be nerve-racking. Often, a driver cannot understand the passengers in the rear seat, not to mention the pianissimo on the car stereo. Actually, though, there are ways to drive this disruptive vibration out of the car. This is possible thanks to "smart materials" – intelligent materials that can tailor their own condition to changing situations with highest speed. The possible applications are diverse and promising – not just for carmakers but also for mechanical engineering and the electronics industry. This is why 11

Fraunhofer Institutes have joined forces to create the "Adaptronics Alliance," making new, "smart" solutions marketable.

Piezoceramic bearings to counteract car noise

Vibrations inside a moving car are just one example among many. Researchers use piezoceramics, a material that transforms electrical energy to motion and conversely dampens vibrations by converting them to electrical energy. They are currently using an upmarket passenger car to test piezoceramic bearings attached to the vehicle between the chassis and a metal frame positioned atop the chassis. Normally, rubber components are used for this purpose, but they are not ideal absorbers of annoying vibroacoustics. As a result, vibrations are audible in the car in the form of noise. The piezo bearings, on the other hand, are electromechanical energy transducer devices, being electronically controlled to counteract and neutralize these bothersome vibrations. The result is a quiet ride. In another project, researchers are taking the opposite approach. There, they are developing piezo components that convert the oscillations in a structure – such as within high-traffic bridges – to electrical energy. This energy

can be used to supply tiny – energy-autarchic sensors that can monitor the condition of the bridge and notify a control center of any damage.

Hard, viscous or watery at the touch of a button

Piezoceramics are not the only materials that can be "smart." An alternative material of interest to Fraunhofer researchers are "magneto-rheological fluids." These fluids contain tiny particles that align themselves to form fixed chains in a magnetic field. The fluid solidifies. Depending on the strength of the field, the fluid is hard, viscous or watery. The Alliance partners have used it to develop a safety clutch for

machinery – for use in motor vehicle drives or milling machines. During operation, the fluid is solid. In this state, it creates a solid linkage between drive shaft and cutter head. Activating the emergency shutoff button switches off the magnetic field. The substance returns to its fluid state. The drive shaft spins freely. The cutter head comes to a standstill.

Specialists from different disciplines work together in the Alliance: Material developers, structural mechanics, electronics specialists and system engineers assemble all of the findings to create a coherent whole. With the current economic upturn, industry experts expect to see additional products based on smart materials on the market in the next two years. "The technology is ready. Work is moving forward on other exciting solutions – from mechanical engineering to the consumer-goods market," notes head of the Alliance Tobias Melz of the Fraunhofer Institute for Structural Durability and System Reliability LBF in Darmstadt. At the HANNOVER MESSE, at a joint stand with other Adaptronics partners, the Alliance is presenting a variety of developments – including a table with vibration-damping bearings, an aircraft component with piezoceramic monitoring sensors and an upmarket passenger car with a smart interior.

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