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DEEP INSIGHTS FOR THE TECH INDUSTRY

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3D-printed ESD protection

Researchers from Lawrence Livermore National Laboratory developed a printable elastomeric silicone foam for electronics packaging that provides both mechanical and electrostatic discharge (ESD) protection.

The team used a 3D printing technique called direct ink writing (DIW), an extrusion process in which a paste with controlled rheological properties such as elasticity, plasticity, and viscosity is deposited layer-by-layer to build up 3D structures.

To print an ESD-protective packaging using DIW, the researchers developed a silicone resin formulation containing carbon nanotube (CNT) concentrates and rheological modifiers (thickeners) that were both printable and reached the conductivity needed for ESD. CNTs were used as a good conductive additive to control the build-up of static electricity while rheological modifiers allowed for the 3D printing of structures with tailored porosities at high resolutions.

Using this resin, the researchers printed the ESD structure directly onto a circuit board. In addition to providing electrical protection of sensitive circuitry, the printed structure also acted as a cushion, which was tested by striking the circuit board with a hammer.

The team plans to make improvements in further iterations of the material and sees potential for its use in medical and robotics applications. [1]

Lower-power PCM

Researchers from the University of Pennsylvania, Indian Institute of Science (IISc), and Massachusetts Institute of Technology (MIT) developed a new method for amorphizing wires made of indium selenide (In_2Se_3) that requires as little as one billion times less power density. They believe the development could unlock wider applications for phase-change memory (PCM).

Information is stored in PCM by switching the material between amorphous and crystalline states. “One of the reasons why phase-change memory devices haven’t reached widespread use is due to the energy required,” said Ritesh Agarwal, distinguished scholar and professor in materials science and engineering at Penn Engineering, in a press release.

Pavan Nukala, assistant professor at IISc, spent years trying to understand the odd behaviors of indium selenide wires. “We learned that multiple properties of In_2Se_3 — the 2D aspect, the ferroelectricity and the piezoelectricity — all come together to design this ultralow energy pathway for amorphization through shocks," said Nukala in a release.

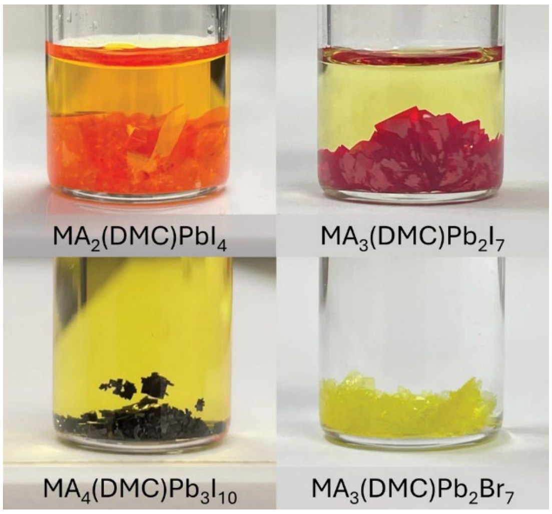
The researchers describe the process as resembling both an avalanche and an earthquake. Initially, tiny sections within the In_2Se_3 wires begin to amorphize as electric current deforms them. Due to the wires' piezoelectric properties and layered structure, the current nudges portions of these layers into unstable positions, similar to the beginning of an avalanche. When a critical point is reached, this movement triggers a rapid spread of deformation throughout the wire. The distorted regions collide, producing a sound wave that moves through the material, similar to how seismic waves travel through the earth's crust during an earthquake. The sound wave drives additional deformation, linking numerous small amorphous areas into a single one measured in micrometers.

"This opens up a new field on the structural transformations that can happen in a material when all these properties come together. The potential of these findings for designing low-power memory devices are tremendous," added Agarwal. [2]

Color-changing perovskites

Researchers from Nanyang Technological University and Hong Kong Polytechnic University synthesized unique types of 2D halide perovskite semiconductors that change color when heated and cooled by incorporating the non-toxic solvent dimethyl carbonate into methylammonium-based perovskite crystals.

The researchers found that the structures' band gap, which determines the color of the material, could be tuned by adjusting the ratio of methylammonium to dimethyl carbonate.



NTU's novel perovskites. (Credit: NTU)

The new 2D halide perovskites, which have applications in solar cells and LEDs, also exhibited a dynamic switchable behavior, changing from orange to red when heated to 80 degrees Celsius and reverting to its original color when cooled to room temperature. The color-changing reaction could be repeated for 25 cycles.

The team sees possibilities for the thermochromic switching phenomenon in applications such as smart coatings and heat-sensitive inks that change color at different temperatures. [3]

References

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