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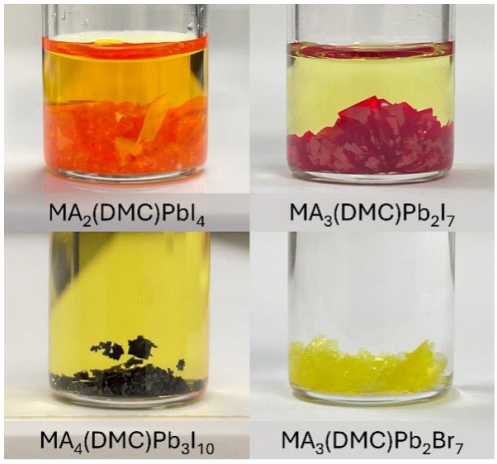
Designing color-changing semiconductor materials

(Nanowerk News) Semiconductor materials called 2D halide perovskites can be used in devices like solar cells and LEDs. Scientists led by Assoc. Prof. Nripan Mathews of NTU's School of Materials Science and Engineering synthesized four unique types of 2D halide perovskites.

Dr. Ayan Zhumekenov, a research fellow at the school and lead author of the study (Journal of the American Chemical Society, "Solvent-templated methylammonium-based Ruddlesden-Popper perovskites with short interlayer distances"), developed the new perovskites using a novel approach. He incorporated dimethyl carbonate—a non-toxic solvent—into methylammonium-based perovskite crystals.



NTU's novel perovskites. (Image: NTU)

By analyzing the new crystal structures, the researchers found that the band gap, which determines the material's color, could be tuned by adjusting the ratio of methylammonium to dimethyl carbonate. The band gap is the energy needed for an electron to escape its bound state and become conductive.

The ability to engineer the band gap's width is vital for various perovskite applications.

The new 2D halide perovskites also exhibit dynamic "switchable" behavior. One of the perovskites could switch between two colored states, changing from orange to red when heated to 80 °C and reverting to its original color when cooled to room temperature.

The researchers demonstrated that this color-changing reaction could be repeated 25 times. This thermochromic switching phenomenon opens possibilities for applications like smart coatings and heat-sensitive inks that change color at different temperatures.

The scientists hope their innovation will advance the technological applications of 2D halide perovskites in optoelectronics and beyond.

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