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PEROVSKITE NANOMATERIALS

Any colour you like

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Full control over the spectroscopic properties of colloidal perovskite nanoplatelets can now be achieved, as William Tisdale and co-workers report in *ACS Nano*. By controlling the thickness, composition and stabilizing agent of the nanoplatelets, light absorption and emission can be finely tuned from the deep ultraviolet to the near-infrared region.

New optical and optoelectronic materials with controllable absorption and emission properties are required for advanced light-based technologies, such as efficient and tunable light-emitting diodes, solar cells, lasers and neuromorphic computing. For many such applications, perovskite-based materials have recently emerged as leading candidates.

The excellent charge-transport properties of bulk metal halide perovskite semiconductors have been widely exploited in solar cells, with power conversion efficiencies exceeding 20%. 2D perovskite-based materials have also been explored as building blocks for solar cells, leading to devices with greater stability to water and air than their bulk counterparts.

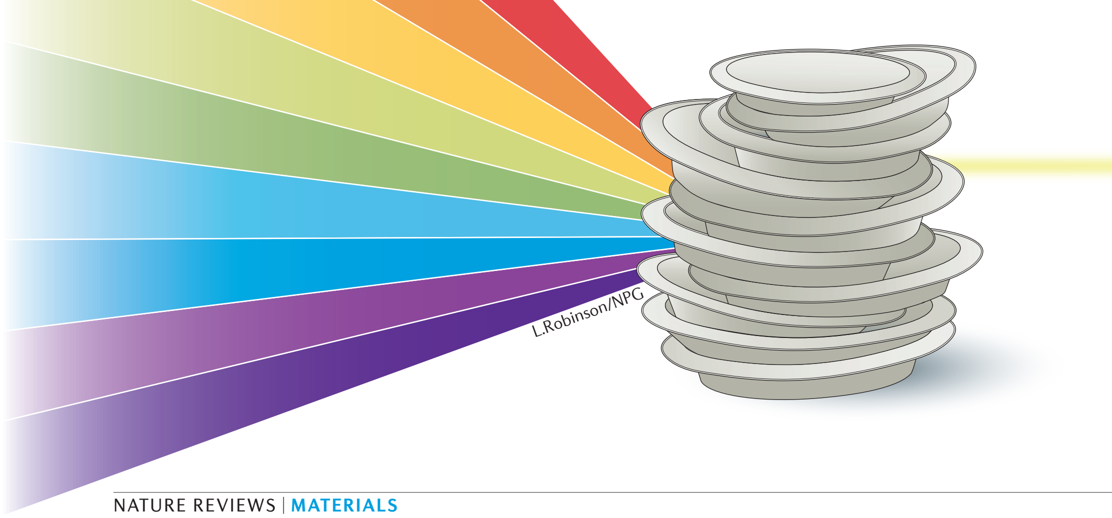
Reducing the dimensionality of these materials even further, like in the case of nanoplatelets, enables new features, such as efficient thickness-tunable optical properties, that cannot be realized in the corresponding bulk perovskite.

Colloidal perovskite nanoplatelets have been synthesized before; however, structural and optical stability have been difficult to attain. "We published the first report of colloidal perovskite nanoplatelets last year, but our synthetic control at the time was poor," says Tisdale, "synthetic advances in the past 12 months made it possible to quickly and reliably produce single-thickness dispersions of perovskite nanoplatelets, enabling us to investigate the optical properties for different structures and chemical compositions."

The nanoplatelet thickness is not the only property that can be tuned to change the optical response: this can also be achieved by changing the chemical composition. The perovskite nanoplatelets have the formula $L_2[ABX_3]_{n-1}BX_4$, where L is the amphiphilic ligand, A is the cation, B is the metal and X is the halide. Changing the halide allows the nanoplatelet emission to be tuned from deep ultraviolet to visible wavelengths, whereas changing the metal allows control within the infrared region. Importantly, the researchers show that the substitution of lead with tin does not affect the brightness of the nanoplatelets and, although the stability of the tin-based nanoplatelets needs to be improved, this is a big step towards heavy-metal-free colloidal semiconductors. The nature of the cation mostly affects the size distribution of the nanoplatelets, which ultimately affects the broadness of the spectral peak. Thus, by changing the thickness and composition, it is possible to tune the absorption and emission in the entire ultraviolet to near-infrared spectrum.

Perovskite nanoplatelets present different electronic and optical features to bulk perovskites, such as a stronger excitonic character and favourable dipole emission profile, which make them exciting materials for light-emitting diodes and lasers. However, some challenges limit the full application of these materials: "Finding ways to stabilize these nanoplatelets remains a challenge: their shape tends to evolve over time and they dissolve if exposed to polar solvents. However, the colloidal nanomaterials community has historically been very good at overcoming such challenges, so I'm optimistic about the future of these materials," concludes Tisdale.

Gabriella Graziano



ORIGINAL ARTICLE Weidman, M. C. *et al.* Highly tunable colloidal perovskite nanoplatelets through variable cation, metal, and halide composition. *ACS Nano* http://dx.doi.org/10.1021/acsnano.6b03496 (2016)

FURTHER READING Tyagi, P. *et al.* Colloidal organohalide perovskite nanoplatelets exhibiting quantum confinement. *J. Phys. Chem. Lett.* **6**, 1911–1916 (2015)