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Inside:

Images incorporated to create the energy puzzle concept used under license from Shutterstock.com. Energy Sector title image: Researchers at the University of Oxford have made metal halide perovskite solar cells that contain tin as the metal instead of toxic lead. Credit: The University of Oxford.

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MRS Bulletin

Perovskites—To be continued

The versatile perovskite structure ABX_3 offers an extensive playing field for solid-state chemists, physicists, and materials scientists since it is exceptionally stable so that most elements of the periodic table can be placed on the A-, B- and X-sites. These compositional variations lead to a multitude of useful properties, from superconductivity to resistance switching, thermoelectric, piezoelectric, and catalytic activity, to name a few. Therefore, it is also commonly called the chemical chameleon (A. Reller, T.B. Williams, *Chemistry in Britain* **25**, 1227 [1989]). Until recently, most of these interesting functions were found in oxide-type perovskites. Thus, it came as a surprise when hybrid lead halogenide perovskites turned out as “the” perovskite materials due to their extraordinary photovoltaic properties that found expression in countless scientific publications worldwide. The soft hybrid material methylammonium lead iodide (MAPI), which was discovered by Dieter Weber in 1978 (D. Weber, *Zeitschrift für Naturforschung B* **33**, 1443 [1978]), became even more famous than the hard oxide-based counterparts. But these materials are completely different from the perovskite-type materials we are using in various applications such as batteries and computers since they are, in contrast, chemically, biologically (due to the methylammonium cation), and thermally rather unstable and decompose in air and moisture. So the huge advantage of the perovskite structure, which allows us to use them in catalytic and other redox reactions or in high-T applications, suddenly vanishes. Nevertheless, this instability problem (which is a disadvantage for their technical application today) might be solved as well as the impurity issue, which was formerly the major objective raised against oxide semiconductors in the first place.

The hybrid perovskite can also be viewed as a derivative of Pb iodide (known as very good ionic conductors), where the conductor is embedded in methylammonium organic matter, leading to interesting PV properties. Even in this system, the strong perovskite structure is holding organic and inorganic parts of the material together.

Therefore, chances are that the oldest and most abundant structure type (remember that the perovskite-type $CaSiO_3$ is building the earth mantle) might bring even more unforeseen surprises in the future.

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