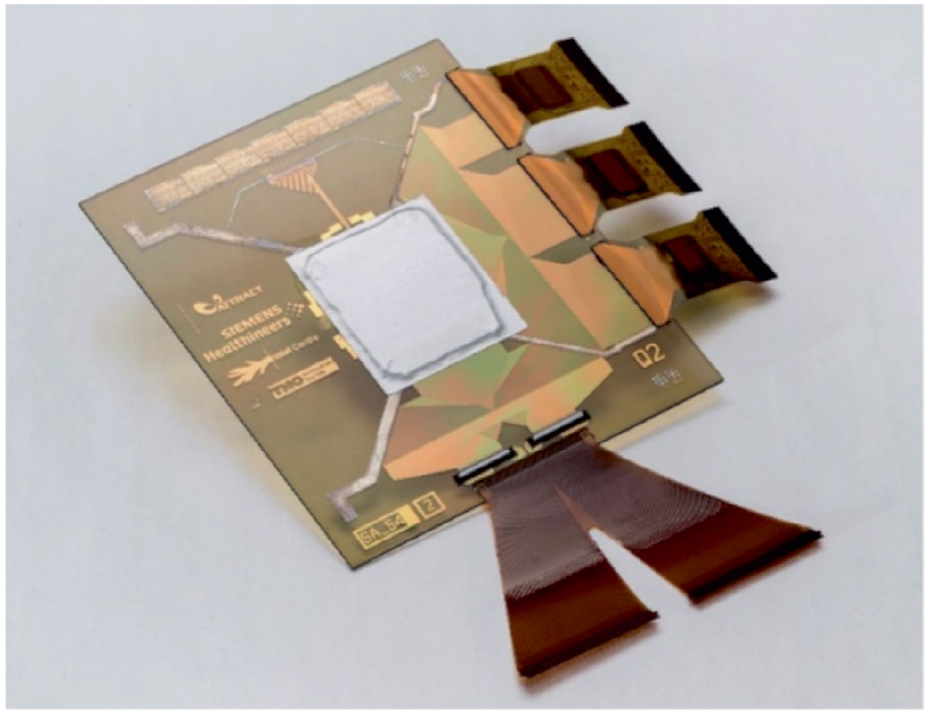
editorial

Perovskite potential

Driven by their achievements in solar cells, metal halide perovskites are being used in a range of other devices — from light-emitting diodes to photodetectors to field-effect transistors — with increasing success.

The Rank Prize, which was established in 1972, is awarded biennially to researchers in the fields of nutrition and optoelectronics. It's an unusual combination of topics, and one that reflects the business interests — in flour milling and film making — of the prize's founder, J. Arthur Rank. This year, the Rank Prize for Optoelectronics has been won by seven researchers for pioneering work on perovskite semiconductor solar cells. They are, in particular, Michael Graetzel of the Ecole Polytechnique Fédérale de Lausanne, Tsutomu Miyasaka of Toin University of Yokohama and the University of Tokyo, Akihiro Kojima of the Zeon Corporation, Nam-Gyu Park of Sungkyunkwan University, Sang Il Seok of Ulsan National Institute of Science and Technology, Henry Snaith of the University of Oxford, and Michael Lee who is editor of *Science Robotics* and formerly one of the editors of *Nature Electronics*. (The 2022 Rank Prize for Nutrition was awarded to Cathie Martin of the University of East Anglia for work on plant genetics and metabolism.)

Perovskite solar cells are based on metal halide perovskites such as methylammonium lead iodide ($CH_3NH_3PbI_3$), which are part of a family of compounds with the same crystal structure and general chemical formula (ABX_3, where A and B are cations and X an anion) as the mineral also known as perovskite, calcium titanate ($CaTiO_3$). The technology has developed rapidly over the past decade or so, leading to devices with power conversion efficiencies of over 25%[1]. The materials are solution-processable, and offer a number of attractive properties including high carrier mobilities, long diffusion lengths and tunable bandgaps. As a result, they are of increasing use in electronic devices beyond solar cells[2], including in light-emitting diodes (LEDs), photodetectors and field-effect transistors.



Photograph of a perovskite X-ray imaging detector. Figure reproduced from ref. [3], under a Creative Commons licence CC BY 4.0.

Progress in perovskite LEDs has — like perovskite solar cells — been swift, and in a Review Article in this issue of *Nature Electronics*, Azhar Fakharuddin and colleagues explore recent advances in the field. The researchers highlight the success of developments in green, red and near-infrared devices, which can now all offer external quantum efficiencies of over 20%, and highlight the various potential applications, which range from displays to telecommunications. But commercial deployment is still restricted by a number of factors including the poor efficiency of blue-emitting devices and a decrease in external quantum efficiency at high current density. And the team — who are based at various institutes in Europe, the United States and South Korea — consider ways in which to address these challenges.

With perovskite photodetectors, relatively sophisticated devices are now a possibility — a fact that has recently been reflected in the pages of *Nature Electronics*. Back in September, for instance, X-ray flat-panel detectors based on metal halide perovskites were reported that offer high spatial resolution and high sensitivity[3]. This was soon followed by a report on flexible image sensors based on metal halide perovskites[4]. These devices can be used for document scanning and biometric fingerprinting, and can be wrapped around objects with diameters as little as around 1 cm.

Work on perovskite field-effect transistors can be traced back to the late 1990s[5], but the potential of such devices has remained more uncertain than their optoelectronic cousins. Recent results are though encouraging. Back in our March issue, for example, high-performance p-channel perovskite thin-film transistors were reported[6]. These devices can exhibit hole mobilities of over 50 $cm^2 V^{-1} s^{-1}$ and on/off current ratios exceeding 10^8. ❐

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