ENERGY DEVICES

Millimetre-scale thin-film batteries on a charge

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This year's Nobel Prize in Chemistry was awarded to John Goodenough, M. Stanley Whittingham and Akira Yoshino for the development of lithium-ion batteries. The applications of this technology, as noted by the prize committee, span the very small (implantable medical devices) to the very large (electric vehicles). For the former, the continued miniaturization of batteries with high energy and power density is important. Sami Oukassi and colleagues from University of Grenoble Alpes, CEA-Leti have now reported a millimetre-scale thin-film battery with an areal energy density of 0.89 mAh cm^{-2} at a current density of 10 μA cm^{-2}, and power density of 0.45 mAh cm^{-2} at a current density of 3 mA cm^{-2}. These values represent state-of-the-art performance relative to other leading thin-film battery technologies.

The solid-state battery developed by the researchers has dimensions of 3.1 × 1.7 mm^2 and a thickness of 95 μm. It is composed of a 20-μm-thick lithium cobalt oxide ($LiCoO_2$) cathode, a lithium-free anode, a titanium current collector and a lithium phosphorus oxynitride (LiPON) electrolyte. The choice of materials was key to the high performance of their battery, and Oukassi and colleagues determined that the $LiCoO_2$ has a high lithium ion diffusion coefficient of around 5×10^{-9} cm^2 s^{-1} and the LiPON an ionic conductivity of 3×10^{-6} S cm^{-1}. They also confirmed that the thin-film batteries are suitable for medical applications by testing their electrochemical behaviour and performance at 37 °C.

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