A-peel-ing way to create new batteries out of old ones

From left: Professor Madhavi Srinivasan, Assistant Professor Dalton Tay and research assistant Kenny Wu Zhuoran are part of a team that developed a new method of using fruit peel waste to extract precious metals from spent lithium-ion batteries, to create new batteries. ST PHOTO: JASON QUAH

A team of seven scientists from the Singapore-CEA Alliance for Research in Circular Economy (Scarce) at Nanyang Technological University (NTU) has developed a new method of using fruit peel waste to extract precious metals from spent lithium-ion batteries in a safe and environmentally friendly way, to create new batteries.

This "waste-to-resource" approach tackles food and electronic waste simultaneously, and supports Singapore's move towards a circular economy with zero waste, they said.

Rechargeable lithium-ion batteries are used in electronic devices like mobile phones and laptops. In recycling, they are crushed to separate out iron, plastic, paper and a "black mass" rich in trace metals.

Conventional industrial methods of recycling battery waste such as smelting, which involves high temperatures of up to 500 deg C, and acid leaching with strong acid solutions generate harmful pollutants.

The NTU team found that a combination of powdered, oven-dried orange peel and citric acid, a weak organic acid, could successfully extract about 90 per cent of cobalt, lithium, nickel and manganese.

The key ingredient in the process was cellulose in fruit and vegetables, which converted into sugars under heat during the extraction process, said co-team leader, Assistant Professor Dalton Tay from the NTU School of Materials Science and Engineering and School of Biological Sciences. "These sugars enhance the recovery of metals from battery waste," he said, adding that the solid residues and by-products generated from this process were found to be non-toxic.

The recovered metals were used in new lithium-ion batteries, which were found to have a similar charging capacity to commercial ones. The scientists are currently working on scaling up the metal recovery process and improving the efficiency of the battery's cycle life to 1,000 charge cycles so that it would be viable for commercial use.

"This waste-to-resource approach could also potentially be extended to other types of cellulose-rich fruit and vegetable waste, as well as lithium-ion battery types such as lithium iron phosphate and lithium nickel manganese cobalt oxide. This would help to make great strides towards the new circular economy of e-waste, and power our lives in a greener and more sustainable manner," said Professor Madhavi Srinivasan, co-team leader and co-director of the NTU Scarce lab.

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