NTU researchers use fruit peels to extract precious metals from old batteries

How appeel-ing.

Sumita Thiagarajan | September 01, 2020, 12:31 PM

An estimated amount of 1.3 billion tonnes of food waste and 50 million tonnes of e-waste are being generated globally.

To tackle both issues of e-waste and food waste, scientists from Nanyang Technological University (NTU) have developed a new way to extract precious metal from old and used lithium batteries using fruit peels that would otherwise just be thrown away.

A cleaner & cheaper way of treating e-waste

Traditionally, spent batteries (or old, used batteries) are treated at high temperatures over 500°C to extract valuable metals to create new batteries.

This method also produces dangerous, toxic gases.

Other methods that aim to recycle batteries also produce pollutants, which pose safety and health risks, or rely on using hazardous chemicals like hydrogen peroxide.

Researchers in NTU have found a better and more eco-friendly way with the help of discarded fruit peels.

Using orange peels, the team demonstrated that you could recover precious metals from old batteries, and even created functional batteries from these recovered metals.

In their lab experiments, the team found that their approach successfully extracted around 90 per cent of cobalt, lithium, nickel, and manganese from spent lithium-ion batteries.

This is a comparable efficacy to other methods, such as using hydrogen peroxide to recycle precious metals.

According to the scientists, their method aligns with the efforts to practice a circular economy, which adopts the following principles, according to the Ellen MacArthur Foundation:

- Design out waste and pollution
- Keep products and materials in use
- Regenerate natural systems

According to Professor Madhavi Srinivasan, who is co-director of the NTU Singapore-CEA Alliance for Research in Circular Economy (NTU SCARCE) lab:

> “Current industrial recycling processes of e-waste are energy-intensive and emit harmful pollutants and liquid waste, pointing to an urgent need for eco-friendly methods as the amount of e-waste grows. Our team has demonstrated that it is possible to do so with biodegradable substances."

Adding on to Madhavi's point, Assistant Professor Dalton Tay of the NTU School of Materials Science and Engineering and School of Biological Sciences said:

> “In Singapore, a resource-scarce country, this process of urban mining to extract valuable metals from all kinds of discarded electronics becomes very important. With this method, we not only tackle the problem of resource depletion by keeping these precious metals in use as much as possible, but also the problem of e-waste and food waste accumulation – both a growing global crisis.”

The team's findings were published in the scientific journal Environmental Science & Technology in July.

How does it work?

Orange peels, or even dried orange peel powder, contains a weak organic acid, which is found in citrus fruits.

Tay explained:

> “The key lies in the cellulose found in orange peel, which is converted into sugars under heat during the extraction process. These sugars enhance the recovery of metals from battery waste. Naturally-occurring antioxidants found in orange peel, such as flavonoids and phenolic acids, could have contributed to this enhancement as well.”

According to the team, by-products from their process were found to be non-toxic, suggesting that this method is eco-friendly and much safer, as compared to conventional methods.

From the recovered materials, they then assembled new lithium-ion batteries, which showed a similar charge capacity to commercial ones.

Moving forward, the scientists are optimising the performance of the new batteries made from recovered precious metals and are looking to scale up production.

The team also hopes to remove the use of acids in the process.

Madhavi said:

> “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.”

Top photo courtesy of NTU