# Power up when the temperature is down

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Transporting power sources in the coldest places may be easier with a new re-chargeable, non-metallic battery from Japan. This "eco battery" could provide portable sources of power in environments like refrigerated factories or extreme winter environments.

Chemists from Hiroshima University developed a new synthesis method for organic radical batteries that are re-chargeable and continue to function at below-freezing temperatures. The specific model prototyped by the Hiroshima University team has greater voltage than previously reported styles from other research groups around the world. The method used to create this battery is an improvement on a report from the same Hiroshima University laboratory earlier in 2016.

Most electrical devices use a lithium-ion battery. Lithium-ion batteries are safer than standard lithium metal batteries, but both styles rely on metal, a finite resource that is in decreasing supply. The same problem of decreasing supply exists for copper and cobalt batteries, like the traditional AA batteries in TV remote controls.

Organic radical re-chargeable batteries have the potential to be cheaper, safer, and longer-lasting than current metal-based batteries, earning them the "eco battery" title. This style of battery can re-charge faster than meal-based batteries, the difference of one minute instead of one hour, because they carry energy chemically rather than physically.

"The chemicals in the battery make it heavy and the synthesis process makes it expensive, so it won't replace other styles of batteries in the

foreseeable future. But our battery could supplement traditional batteries in conditions where traditional Lithium-ion batteries can't work reliably, particularly in cold locations," said Professor Yohsuke Yamamoto, Ph.D., from Hiroshima University.

Eventually, organic radical batteries could potentially be made in flexible, transparent forms for use in wearable electronics.

The new organic radical synthesis method from the team of researchers at Hiroshima University is modeled on a process first report in 1985 by an American research group. Yamamoto was a member of that lab in the late 1980s and improved the process in recent years as part of work on unstable organic compounds.

"The original method we used took such a long time and relied on harmful chemicals. Now, over 20 years later, we can synthesize the compound much more quickly and safely.

"Fundamental research on unstable compounds creates a more detailed understanding of how chemicals bond. Applications like this new battery are the results of research that was never originally about any specific end product," Yamamoto said.

Yamamoto and collaborators are currently adapting the synthesis process further to make the battery lighter weight and ensure it retains its energy output after numerous re-charge cycles.

**More information:** Yasuyuki Imada et al. Easy Access to Martin's Hypervalent Sulfur Anions toward an Electrode Material for Organic Rechargeable Batteries, *Bulletin of the Chemical Society of Japan* (2016). DOI: 10.1246/bcsj.20160012

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