Dongguk University Researchers Develop Novel Electrode Material for Hybrid EV Supercapacitors

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Researchers at Dongguk University in South Korea have designed and synthesized a novel hybrid composite electrode material that significantly enhances the performance of supercapacitors for use in hybrid electric vehicles (HEVs).

The composite electrode consists of cobalt selenide nanorod-copper selenide polyhedron-decorated over graphene oxide (CCS@GO). The researchers say it offers unprecedented electrochemical properties, having demonstrated an ecofriendly, economical fabrication, improved charge storage and retention, increased energy and power density attributable to the unique morphology of the electrode material.

Next-generation electronic devices and hybrid electric vehicles (HEVs) need excellent charge storage devices to function well. Currently, the majority of the charge storage devices are made from conventional metal sulfide or metal oxide-based supercapacitor electrodes.

However, poor electrical conductivity and low energy density are major challenges in the use of supercapacitors, limiting their commercial applications.

In contrast, transition metal selenides offer several enhanced electrochemical properties due to their in-built advantageous physicochemical properties including high chemical stability, a narrow bandgap, and low electronegativity that leads to a faster electron-conducting rate than that of metal sulfides and oxides.

“A composite formed by the combination of metal selenides and carbon template is a fascinating approach to tune the properties of electrodes for electrochemical applications” said Professor Hyun-Seok Kim from the Division of Electronics and Electrical Engineering,

Dongguk University, Seoul, South Korea. “Based on this idea, we have designed and constructed a new hybrid composite electrode comprising cobalt selenide nanorod-copper selenide polyhedron-decorated over graphene oxide (CCS@GO), using a wet-chemical strategy.”

Professor Kim has been actively researching 2D materials and nano- and micro-electronics for energy and sensor devices.

In a recent article made available online on August 9, 2021, and published in volume 427 of Chemical Engineering Journal, Professor Kim and his research team demonstrated that the resultant composite electrode provides abundant space for migration of ions, and allows swift faradaic redox reactions leading to high storage performance in an electrochemical cell.

The team attributed the enhanced electrochemical features to the unique morphology and high surface area of the novel electrode material. They established that the synthesized electrode has outstanding electrochemical charge storage and retention properties. Using the electrodes, they constructed an asymmetric supercapacitor device with a capacitance of 192.8 Fg-1 @ 1A g-1; energy density of 54.6 Wh kg-1; power density 700 W kg-1, and capacitance retention of about 82.5 percent over 10,000 cycles.

“We achieved our ultimate goal of constructing an electrochemical supercapacitor with improved electrochemical activity and long-term durability” added Professor Kim.

Moreover, the team employed an ecofriendly, cost-effective, energy-efficient, wet-chemical fabrication method with earth-abundant copper and cobalt source materials for developing the new electrodes. Taken together, this development paves the way for user-free, non-flammable energy storage materials for next generation electronic and electrical devices.

Read the original article on Dongguk University.