Low-Cost Graphite Anodes for Lithium Ion Batteries

Technology Summary
In the past, worn rubber tires were generally sent to landfills, but more recently, ground rubber from worn tires has become useful in a variety of applications. Researchers at Oak Ridge National Laboratory (ORNL) have developed a process for pyrolysis-based recovery of carbon black from waste rubber tires for value-added use as an active electrode material in lithium ion batteries.

In 2003 nearly 290 million scrap tires were generated in the United States; almost 80% of those waste rubber tires were used in applications for fuel; as additives in civil engineering applications; as additives in plastics, rubbers, and asphalt after grinding into powder form; and for miscellaneous uses in agriculture and other industries. The waste tire rubber is usually cryogenically pulverized into micron-sized rubber particles or ground into a powder for use as filler in various low-cost rubber or plastic products.

ORNL researchers have recovered carbon black composites from powdered tire rubber. Digestion of rubber powders in a hot oleum bath before pyrolysis yields sulfonated rubber powder. It is then filtered, washed, and compressed, followed by pyrolysis, producing a solid carbon cake with a slightly higher yield. When the recovered hard carbons are treated properly before or during carbonization, they can yield very high surface area pyrolytic carbon black composites. To avoid potential impurities such as metal particles in the carbon powder, the powdered rubber can be washed with aqueous hydrochloric acid, nitric acid, or an acidic salt during the recovery process.

Once the carbon black-containing product is recovered, researchers can form a battery electrode from the material, and it can be used as an anode for either lithium ion or sodium ion batteries.

Advantages
- Reduction of worn rubber tire waste entering landfills
- Equal or better performance to comparable commercial carbon powders at an estimated 50% reduction in cost
- Anodes exhibit a reversible capacity of 400 mAh/g—even after ~100 cycles

Potential Applications
- Catalyst support
- Environmental applications such as water filtration, gas sorption, and storage
- Low-cost, rechargeable anodes for lithium ion batteries and other energy storage devices such as supercapacitors and sodium ion batteries

Patents

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