PRINTCAP - Next Generation of 3D Printed Structural Supercapacitors

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ABSTRACT:

Efficient energy storage solutions with structural lightweight capabilities are crucial for advancing electromobility and sustainable energy storage systems. The PRINTCAP project addresses this challenge by developing structural supercapacitors (SSC)—multifunctional materials that integrate mechanical integrity with high-performance energy storage. Unlike conventional supercapacitors, PRINTCAP leverages additive manufacturing (AM) to tailor SSC architectures closely to the final product's shape, optimizing space utilization and mechanical stability. The project focuses on novel composite-based SSC electrode materials [1]. A key innovation of PRINTCAP is the fiber 3D printing process, which enables precise fabrication of SSCs while dramatically reducing material waste and overall weight. The integration of SSCs into transportation, electronics, and aerospace applications promises up to 27% weight reduction in energy storage systems, thereby enhancing energy efficiency and performance. The project also incorporates life-cycle assessment (LCA) studies to ensure environmental sustainability and recyclability of SSC components. Beside developing solid-state high ionic-conductive electrolytes to improve structural integrity and environmental stability, the major research focus lies on inventing load-bearing carbon fibers with an advanced pore structure and functionalized with vertically aligned carbon nanotubes (VACNT) to enhance surface area and charge storage capacity [2, 3]. PRINTCAP establishes a foundation for future scalable manufacturing processes of SSC, with potential applications in electric vehicles, structural batteries for consumer electronics, and energy-storing aerospace components.

References

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