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Multifunctional Composites with Integrated Energy Storage: Structural Batteries for Next-Generation Electric Vehicles

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Abstract: *The electric car trend in the automotive industry is creating an increased need for lighter and more efficient ways to store electricity for vehicles so as to address the range limitations and the added weight of conventional battery packs. Therefore, the use of structural batteries has emerged as a new way to create multi-functionality from composite materials. In this paper, we review recent developments in the area of structural battery composite materials for the purpose of improving the performance of electric vehicle (EV) designs by reviewing various types of structural battery composite architectures; the mechanical-electrochemical relationships within these composites; the challenges related to manufacturing structural battery composites; and, the performance characteristics of structural battery composites. Additionally, we examine carbon fiber based structural electrode, solid state electrolyte, and novel cell architectural concepts that may be able to decrease vehicle mass by 20-30% by simultaneously reducing the overall energy density of the structural battery while increasing structural integrity. We discuss key technical challenges that include issues related to interface compatibility, thermal management, safety concerns, and scalability of structural batteries. Finally, we provide a summary of future directions to develop commercially viable structural batteries that can eliminate the distinctions currently existing between the structural component and the energy storage component of electric vehicles.*

Keywords: Structural batteries, multifunctional composites, electric vehicles, carbon fiber electrodes, solid-state electrolytes, lightweight design, energy storage

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