The Challenges and Opportunities of Advanced Materials in Automotive Applications

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ABSTRACT:

Advanced materials are essential for boosting the fuel economy of modern automobiles while maintaining safety and performance. A 10% reduction in vehicle weight can result in a 6%-8% fuel economy improvement, since it takes less energy to accelerate a lighter object than a heavier one. Using lightweight components and high-efficiency engines enabled by advanced materials in one quarter of the U.S. fleet could save more than 5 billion gallons of fuel annually by 2030.

While any vehicle can use lightweight materials, such as carbon fiber composites, magnesium alloys, aluminum alloys, or advanced high strength steels, they are especially important for internal combustion engines, hybrid electric, plug-in hybrid electric, and electric vehicles. Using lightweight materials in these vehicles can offset the weight of power systems such as batteries and electric motors, improving the efficiency and increasing their all-electric range. Alternatively, the use of lightweight materials could allow for the use of a smaller and lower cost battery while keeping the all-electric range of plug-in vehicles constant.

The U.S. Department of Energy's Vehicle Technologies Office (VTO) supports research, development, and deployment of efficient and sustainable highway transportation technologies that will improve fuel economy and enable America to use less petroleum. These technologies, include plug-in electric vehicles (also known as PEVs or electric cars), batteries, electric drive technologies, advanced combustion engines, lightweight materials, and alternative fuels, will increase Americans' mobility and energy security, while lowering costs and reducing environmental impacts. VTO collaborates with industry, academia, and national laboratories to develop and deploy advanced vehicle technologies, including highly efficient combustion engines, lightweight materials, and electric drive vehicles. These technologies can lead to significant fuel economy improvements and replace oil with domestic fuels, setting the foundation for clean, efficient, sustainable, and cost-competitive vehicles. This presentation will look at the current use of advanced materials in the automotive industry and the potential that these materials offer for weight reduction and a corresponding fuel use reduction in future vehicles. The advantages of using advanced materials in future vehicles will be explored and the technology gaps that inhibit greater use of these materials will be investigated.