Supercabatteries as a step forward for micro-mobility power units

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Abstract

Urban mobility in the last decade is facing radical changes due to the need to solve problems such as excessive traffic or the high air pollution that internal combustion engine cars generate. Our goal is to promote sustainable micro-mobility that goes to limit the use of private vehicles especially for short trips. At present, the accumulator in these vehicles consists mainly of lithium-ion cells, with important trade-offs in the useful life of the vehicle itself. We are considering making a technological shift by going to use a particular type of supercapacitor, called *supercabatteries*, whose life is up to 20 times longer than current lithium-ion cells to counter the obsolescnece of this part of the vehicle

The Problems of urban mobility

In major European cities over the past decade, private urban mobility is undergoing a revolution: using a car for all kinds of travel, even those under 5 kilometers, and mostly alone is completely unsustainable. This has major quality-of-life repercussions, both in terms of excessive air and noise pollution, excessive travel time, and the low versatility of such vehicles in cities where ZTL and other traffic-restricted areas are constantly increasing. This does not mean that one should demonize the private car in favor of the use of public transportation for personal travel, as it would represent a severe restriction on personal freedom, but that one should seek to incentivize the use of less impactful and more sustainable means of travel. The transition to all-electric vehicles desired by the European Union in 2035 certainly helps, however it only solves some problems, such as less environmental impact than internal combustion engine vehicles, reduced pollution and lower air pollutants such as NOx. Other problems, such as high congestion in urban centers, will remain and others will arise, for example, related to the inadequacy of the current power grid or dependence on raw materials. It is crucial to emphasize that all this does not solve the paradox of automobiles: to move one person and/or a small load requires at least 1200kg of vehicle and 0.15-0.5 kWh/km of energy. One of the most effective solutions is not only to try to incentivize public transportation, enhancing its ubiquity and accessibility, but also to try to incentivize personal micro-mobility as much as possible by spreading a whole range of light electric vehicles, both private and shared, also suitable for transporting small loads such as cargo bikes or quadricycles.

Accumutars in the microvehicles

There was an initial attempt at incentives in 2020, but a lack of regulations to ensure good construction cast a shadow over this category of transportation. Problems with the build quality of the chassis and the rapid obsolescence of the batteries quickly became apparent. The latter, consisting almost entirely of lithium-ion batteries, usually have a limited life of about 1 to 3 years as they are subjected to severe thermal and mechanical stress and deep charge and discharge cycles due to technical problems.

The *supercabatteries* as a great advance in technology

The goal of our research is to encourage the use of micro-mobility vehicles equipped with accumulators formed by hybrid supercapacitors, which in our specific case given their characteristics are also called superchargers. This name comes from the union of the initial part of "supercapacitor" and "battery," since an electrode between the anode and cathode adopts charge storage mechanisms equal to those of batteries. Their main feature that differentiates them from regular batteries is that they have a charge/discharge cycle life up to 20 times longer. In addition, they can operate well down to temperatures of -40°C and have no problems related to thermal runaway. This type of hybridization makes it possible to have single cell operating voltages that are almost completely equal to their battery counterparts, thus allowing refitting operations without going to the extent of disrupting the control structure of the accumulator. This technology shift has important implications for the sustainability of the accumulator and the vehicle, especially in terms of recycling, repairability, and mitigation of all those issues due to the end-of-life of the latter.

References

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