УДК 338.24(075)
UDC 338.24(075)

ПРОРЫВЫ В ТЕХНОЛОГИИ БАТАРЕЙ ДЛЯ ЭЛЕКТРОМОБИЛЕЙ

Т. АЛМАТАЕВ, Д. МОЙДИНОВ, А. ЗОКИРЖОНОВ

Аннотация: В данной статье мы обсудили текущую ситуацию в сфере преодоления будущих вызовов, таких как изменение климата, глобальное потепление и утрата природы. Одним из решений будет принятие более строгих требований в отношении использования традиционных транспортных средств, которые могут выделять CO_2. Кроме того, мы определили важность электромобилей для преодоления будущих вызовов.

Ключевые слова: Климат изменение, выбросы, электромобильность, батарея, экологически чистый.

BREAKTHROUGHS IN BATTERY TECHNOLOGY FOR ELECTRIC VEHICLES

T. ALMATAEV, D. MOIDINOV, A. ZOKIRZHONOV

Abstract: In this article, we have discussed the current situation of the ways to overcome future challenges such as climate change, global warming and the loss of the nature. One resolution will be to adapt stricter requirements regarding the usage of conventional vehicles which can produce the CO2 emissions. Moreover, we identified the importance of electric vehicles to overcome future challenges.

Key words: Climate, change, emission, electric mobility, battery, eco-friendly.

We explored the present state of addressing impending challenges such as climate change, global warming, and biodiversity loss. One proposed solution involves implementing more stringent regulations concerning the usage of conventional vehicles, which are significant contributors to CO_2

emissions. The vast majority of emissions in most countries come from cars, which despite the rapid growth of EVs are still overwhelmingly reliant on oil-based fuels. In Uzbekistan 14 percent CO_2 emission comes from directly from transportation [1]. Another impact of the issue is the strong urbanization and the general population's increasing interest. These factors will indicate the need for pollution-free alternative to the existing conventional vehicles that are driven by internal combustion engines. In this period, the level of acceptance new forms of mobility such as eletromobility which also enables the potential growth of electric vehicles next upcoming future. There is a pressing need for transformation not just in future passenger cars, but also in buses and off-road vehicles. Recent advancements in electric propulsion systems offer promising solutions for all these vehicle types. Moreover, alongside the challenge of escalating fuel prices, the substantial operating costs incurred over the lifespan of these vehicles underscore the importance of transitioning to electric mobility solutions.

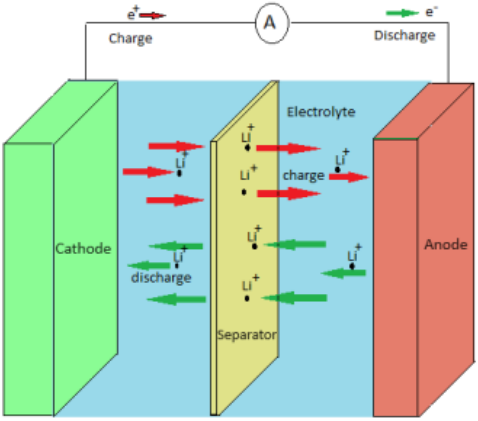
Main Part:

When it comes to identify the development paths of electric vehicles, the main components are battery management system and suitable charging stations. The innovation battery management system in general plays a vital role in determining technical attributes like performance and range. Batteries of EVs can be different for example, lead-acid, nickel-metal hydride or lithium-ion (Li-ion). They are varying from each other by their energy and power density. The fundamentals of the battery electric vehicle have a powerful electric motor and a well-structured battery system and Picture 1 can be the good example. This type of vehicles is including the electric motor so they do not have combustion engines, fuel tank and even exhaust system.

Picture 1 – The battery electric vehicle

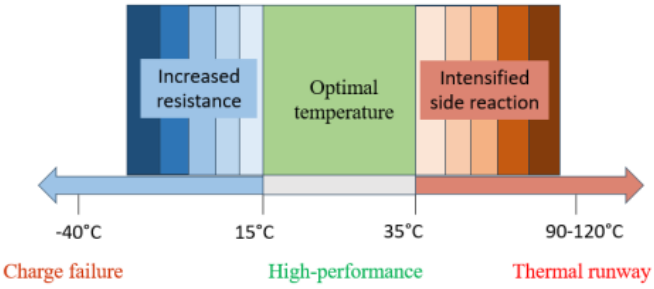
One of the main requirements for electric vehicles is driving mileage and power. Another vital requirement is lifetime of the batteries. The Li-ion is to be designed in such a way that full capability is longs over at least 10 years considering of customers driving purposes. The battery as a source of electrochemical storage got wide popularity after the invention of rechargeable batteries, lead-acid batteries. The term battery, especially the lead-acid type, very common in the automotive application, as it served the purpose of starting multi-cylinder Internal Combustion Engine Vehicles. Though the history of batteries dates back to the days of ICEVs, the non-availability of high energy density, compact rechargeable batteries made the automotive industry dominant with ICEVs [2]. However, due to fossil fuel run automotive population explosion and associated fuel and pollution crises, EVs started again entering in to main stream of passenger fleet. The good attributes of PEVs or BEVs are its zero local emissions, less noise, high efficiency and advantage of regenerative braking energy [3].

LIB being high energy density, compact have become versatile choice for adoption in many electronic gadgets and EVs and thus LIB is overwhelming choice for EVs. Similar to any electrochemical cell or a battery, the essential components of a LIB cell are cathode, electrolyte, separator and anode. Lithium-ions are stored in anode during charging and they move to the cathode during discharging. A schematic of a LIB cell depicted in picture 2 [4].



Picture 2 – A schematic of Li-ion Battery

The variations in temperature greatly affect the performance of LIBs. The operational range of temperature depends on the type of battery normally ranges from −40 °C to 60 °C. However, the optimal performance of the battery of EVs is typically obtained in the range of 15°C and 35°C [5]. The efficiency, power and energy reliability and longevity of an LIBs electrochemical system are severely affected with the differences in temperature of the battery [6]. The temperature dependent performance of LIBs is shown picture 3. The ambient temperature in certain regions both hot and cold would be above outside the optimal performance range. Any operating temperature outside the range of optimal performance deteriorates the battery performance leading to TR and finally results in fire or catastrophic hazards with propagation of flames to the surrounding materials.



Picture 3 – Li-ion Battery Performance

This necessitates proper cooling in high temperature regions and heating low-temperature regions. In low temperature regions of working, heating elements are used to maintain and control safe working temperature besides keeping proper chemical reactions in a cell. Therefore, under hot operational or ambient conditions, it is essential to mitigate the average temperature and to maintain uniform temperature distribution between the cells and adjacent surfaces and thereby safeguard the batteries from excessive heating. In this regard, the requirement of Battery Thermal Management System is highly essential. An effective Battery Thermal Management System is mandatory to enhance the performance, life span, safety and reliable operation of working batteries and EVs.

REFERENCE

1. How much CO2 does Uzbekistan emit? [Electronic resource]: Access mode – https://www.iea.org/countries/uzbekistan/emissions.

2. James Larminie, John Wiley «Electric vehicle technology», 2012.

3. Zhenhe Li, Amir Khajepour , Jinchun Song «A comprehensive review of the key technologies for pure electric vehicles Energy» Volume 182, 2019, Pages 824-839.

4. Goodenough, J.B., 2018. «How we made the li-ion rechargeable battery» Nat. Electron. 1, 204.

5. Wang Q, Jiang L, Yu Y, Sun J. «Progress of enhancing the safety of lithiumion battery from the electrolyte aspect» Nano Energy 2018; 55 :93–114.

6. G. Olabi, Hussein M. Maghrabie, Ohood Hameed Kadhim Adhari, Enas Taha Sayed, Bashria A.A. Yousef, Tareq Salameh, Mohammed Kamil,Mohammad Ali Abdelkareem «Battery thermal management systems: Recent progress and challenges, International Journal of Thermofluids» 15 (2022) 100171.