DESCRIPTION FOR THE GENERAL PUBLIC

The lithium-ion battery with a graphite anode is currently widely used as an energy source in portable electronic devices, such as smartphones and laptops. The main limitation of currently used lithium-ion batteries is their capacity, which is becoming insufficient for the rapidly growing energy and storage sector. In recent years, much attention has been paid to the study of novel anode materials for lithium-ion batteries to improve their capacity and energy density. Due to its unique properties, three-dimensional (3D) graphene has great potential as a new active anode material. Better results for the anode based on 3D graphene materials were explained by the excellent properties of three-dimensional graphene structures, including the additional empty space. Researchers to date have not directly addressed the issue of the free space inside 3D graphene material. The research has tended to focus on the possibility of storing lithium ions between the layers of 3D graphene rather than inside the hollow structure of a graphene spherical shell. Furthermore, the impact of this free space on the efficiency of lithium-ion batteries has also not yet been elucidated.

Therefore, the purpose of this project is to investigate the role of the free space inside the 3D graphene material on the possibility of storing there lithium ions during the charging and discharging processes of Li-ion battery and to develop the effective transport of the lithium ions into and out of the free space. As part of the project, 3D graphene spheres will be prepared in three different sizes and different amounts of hollow space will be considered. Based on the measured differences in capacity, the optimal volume of empty space and corresponding theoretical capacity will subsequently be estimated. In order to improve the effective transport of the lithium ions into and out of the free space during battery operation, additional paths (holes) in the graphene layers will be developed by heating in air. The introduction of additional defects in the graphene structure as additional pathways for the penetration of Li ions may improve the flow of lithium ions into and out of the free spaces inside 3D graphene during charging and discharging process.

The obtained research results will allow to determine the relationship between the empty space inside 3D graphene materials (3D graphene spheres) and the capacity of these structures. After conducting the proposed experiments, we expect to obtain new, valuable information on the role of the volume and size of the free space inside the 3D graphene material and the role of the degree of structural defects on the capacity and efficiency of Li-ion storage. The implementation of the proposed research will contribute to broadening the knowledge of porous, three-dimensional graphene materials and will allow the synthesis of many new, innovative materials applicable in lithium-ion batteries.