Methods of producing a polymer electrolyte on the surface of a 3D structure for lithium-ion batteries

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Three-dimensional microbatteries (3D-MBs) are energy storage devices intended for a large range of microelectronic applications. To date, a large number of various 3D electrodes have been developed (nanotubes, nanopillars and porous foams). However, electrolyte systems for these electrodes have not yet been implemented [1].

Solid polymer electrolytes (SPEs) have several advantages, such as leakage-free, low flammability, flexibility, electrochemical stability, high safety and excellent thermal stability [2], which allows their use in solid 3D batteries. SPEs facilitate the attainment of thin, flexible and adhesive coatings on microscopic surfaces.

Gel or polymer electrolytes into 3D-MBs could be received by soaking a polymer matrix with conventional liquid electrolytes or by electrodeposition polymer layers directly on electrode surfaces [1].

In this research, we compared two methods for producing a polymer electrolyte polymethylmethacrylate (PMMA) on the surface of a 3D structure of Ni foam by drop coating [3] and electropolymerization [4] methods. Ni foam acts as a 3D electrode, because it has an uneven structure. The method of applying a droplet coating was carried out by dropping a solution of PMMA on a Ni foam in a glove box in an argon atmosphere.

The electrochemical deposition of PMMA polymer electrolyte onto Ni foam has been accomplished using a cyclic voltammetry (CV) technique. At the potential 2.6V the formed polymer is anchored firmly to the cathode even in a good solvent for it.

The studies of surface grafting polymers were carried out by microscopic investigation and structural characterization. The obtained PMMA film has a uniform fine structure.

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