The progress of electric vehicles (EVs) and electrical energy storage (EES) is hindered due to the limited energy density of the present Li-ion battery and safety issues related to the use of flammable organic liquid electrolyte. The objective of this research is to produce an all-solid-state rechargeable Li battery that uses an inorganic solid material as an electrolyte. First we designed and constructed a model battery to use and to test electrochemical properties of electrodes with a fast-Li$^+$-ion conducting solid electrolyte. Li$_{1.3}$Ti$_{1.7}$Al$_{0.3}$ (PO$_4$)$_3$ is used as a solid electrolyte and LiMn$_2$O$_4$ is used as our anode and cathode. The anode electrode, the solid electrolyte, and the cathode electrode were pressed together into a three-layered pellet with 7 mm in diameter. We found that the cell impedance decreases by increasing the pressure, which generates higher Li-ion conductivity by providing better contact between solid electrolytes and solid electrode. When the cell is charged, it produces 1 voltage. After optimizing the cell components, the new anodes and cathodes will be used to manufacture all-solid-state Li rechargeable batteries with a high energy density. More will be discussed during presentation. The expected result of the research is to manufacture a product that can replace the existing electrodes and be introduced in the extensive Li-ion battery market for plug-in hybrid electric vehicles (PHEVs) and EVs. Furthermore, the high-energy-density Li rechargeable battery produced in this project can be valuable to the next-generation electrochemical devices.

$^1$Department of Engineering and Technology, Indiana University-Purdue University Indianapolis, Indianapolis, IN 46202

$^2$Department of Chemistry, Indiana University-Purdue University Indianapolis, Indianapolis, IN 46202

This study was sponsored by the Indiana University-Purdue University Indianapolis Multidisciplinary Undergraduate Research Institute (MURI) and departmentally funded (Mechanical Engineering).