Electric Materials and Nanotechnology Lab
Department of Electrical and Computer Engineering
https://www.ndsu.edu/pubweb/~qifzhang/

Welcome to Fadhilah's Final Exam / Master Degree Defense

# THE EFFECTS OF DOPING ON THE LITHIUM IONIC CONDUCTIVITY OF LLZO SOLID-STATE ELECTROLYTE

Fadhilah Ahmed Altayaran
Advisor: Qifeng Zhang

**When:** 3:30pm (CST), Tuesday, 11/17/2020

**Where:** NDSU Engineering Conf Room 106

Zoom link:
https://ndsu.zoom.us/j/94072425729?pwd=emV4TVFmV3JPdCtRR1pmWkhnWlVEQT09

## Abstract:

Lithium-ion batteries (LIBs) employing solid-state electrolytes are considerably safer and might potentially generate a higher energy density compared to the conventional lithium-ion batteries with liquid electrolytes. The primary goal of this thesis is to investigate the synthesis and stability of doped $Li_7La_3Zr_2O_{12}$ (LLZO), aiming to achieve the best electrochemical performance. The reason of adopting LLZO is because the material with a cubic phase presents a relatively high lithium-ion conductivity, good environmental stability and electrochemical stability against metallic lithium. The major investigation method involves preparing LLZO powder, pressing it to pellets, sintering the pellets at 1230 ºC and coating metal electrodes on the two side of them, followed by the measurement of the lithium ionic conductivity through Electrochemical Impedance Spectroscopy (EIS) and the characterization of morphology and crystal structure of the material with Scanning Electron Microscopy (SEM) and X-ray diffraction (XRD). Doping has proven to be an effective way to increase the concentration of mobile lithium ions and promote the disorderliness of crystal structure, and therefore can remarkably improve the lithium ionic conductivity of an LLZO substance. In our research, multi-doped LLZO with Al and Ta and F presented the highest conductivity $\sigma = 1.67\times10^{-4}$ $Scm^{-1}$ at room temperature. Our study suggests that the adoption of suitable dopants and optimizing their combination may lead to a significant increase in the lithium ionic conductivity of LLZO solid-state electrolyte.