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2018 PROJECT SUMMARY

Name(s)

Sahil Jog; David Kim; Ishan Modi

Project Number

38516

Project Title

Assessing the Electrochemical Performance of Mg(TFSI)2 in Electrolyte Tetraglyme at Different Environmental Conditions

Abstract

Objectives/Goals

The objective of this experiment is to fully understand the electric potential behind a Mg battery, along with the thorough analysis of its SEI layer, for the purpose of mass production of a new efficient battery.

Methods/Materials

Tube Furnace, Vacuum Seal, Argon Gas, Mg(TFSI)2 Sample produced dry sample of Mg(TSFI)2 under controlled environment. Wet sample was produced in normal conditions. Samples were hooked to a bob cell, in order to test their electric potential, measured with a computer program transmitting Cyclic Voltammetry. SEI Layer was measured with XPS, EDS, SEM, and XRD.

Results

After creating the electrolyte, the cell was tested through Cyclic Voltammetry and went through 50 cycles of reversible deposition/dissolution, which clearly show a noticeable difference in the current performance for the wet sample and the dry sample. The wet sample as shown, creating a mere fraction of mA/cm over voltage compared to the dry sample which were represented in whole numbers. Furthermore, steps were taken to analyze the surface of the anode, in order to understand the SEI layer. Using a SEM, clusters of Mg and other elements are visible on the surface. EDS mapping is done on the magnified clusters, for the purpose of determining the significant presence of Mg and oxygen over other elements. After finding which elements were in the clusters of Mg, XPS was used to find the binding energy of each compound such as MgO and MgS to confirm which elements that Mg is bonded to as it can create an SEI layer. Furthermore, XRD was used to also confirm the crystal structure in which one can find the matching peaks to further confirm that unwanted elements were present in the battery.

Conclusions/Discussion

As predicted, the hypothesis was correct as low water content would be dominant over the subject with higher water content. The benefits that come with this can be overwhelming, since this will give a general understanding where Mg batteries could be the most efficient, and could potentially replace Li-ion batteries, which are characterized as being more combustive, less abundant, and have a potential of forming dendrites that short circuit the battery. Using Mg would change this however, since it is the 4th most abundant metal on the planet, meaning low cost of production, has no dendrite formation during reversible plating/stripping, and have a higher volumetric capacity than of Li batteries.

Summary Statement

After using Cyclic Voltammetry for both dry and wet samples, we can clearly see that the dry sample produced much greater electric potential, implying that a Mg(TFSI)2 battery worked best in dry conditions.

Help Received

We built and tested the Mg battery by ourselves. Also, we got help in further understanding the electrochemical functions, and data interpretation from Prof. Guo in the Bourns Engineering Department at UCR.