**Prognostics and Health Management of Batteries and Composites**

**Introduction**

- Prognostics and health management (PHM) algorithms track the health condition of a system and make an assessment of the time until which this system can perform within desired specification.

- I will be working on PHM of Lithium Iron Phosphate (LiFePO$_4$) batteries and Carbon-Carbon Composites (CCC).

**Electrochemical Theory**

The electrochemical reaction of LiFePO$_4$ undergoes phase transition between FePO$_4$ to LiFePO$_4$. I will be using the equation below.

\[ \text{LiFePO}_4 \rightarrow \text{FePO}_4 + \text{Li}^+ + e^- \]

Lithium ion diffusion coefficient and exchange current density will be calculated by the equation given:

\[ J = \frac{\sigma \omega^{-1/2}}{C^{1/2}} \]

Where $J$ is the exchange current, $\sigma$ is area of electrolyte interface, $R$ is gas constant, $T$ absolute temperature, $n$ number of electrons per molecule during oxidation, $F$ Faraday's constant, $D_i$ diffusion coefficient, $C$ concentration of Li ion, $\omega$ angular frequency.

**Lithium Iron Phosphate Batteries**

LiFePO$_4$ is positive electrode used for portable electronics, hybrid electric vehicles (HEV), plug-in HEV (PHEV), laptops, aircraft, space craft, rovers etc.

- LiFePO$_4$ has high capacity of about 170mAh/g.
- High stability during lithium extraction/insertion
- Good chemical and thermal stability
- Cheap and easy for production
- Environmentally friendly in production and recycling.

**Carbon-Carbon Composites**

Carbon-carbon composites (CCC) were originally developed for aerospace industry and later for racing cars. These are used in nose cone and wing leading edges in aircraft and space shuttle because of its cost effective solutions for furnace fixtures applications.

- The method of finding the structural damage and prognosis will be done by employing build-in sensor/actuator network and numerical simulation method of damage estimation and propagation.

- The goal for this work is to integrate the above method for SHM/PHM in CCC.

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