Substituted $LiCoPO_4$ as Li-ion Cathode

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There is strong interest in electrode materials for Li-ion batteries that function near 5 V for their high energy storage potential. With this in mind, $LiCoPO_4$ has been thought of as a promising cathode material owing to its high discharge voltage of around 4.8 V.[1] The structure of $LiCoPO_4$ is shown in figure 1 and a comparison of the discharge voltage of $LiCoPO_4$ to the discharge voltage of the isostructural $LiFePO_4$ is shown in figure 2. Initial results on $LiCoPO_4$ showed a severe loss of discharge capacity upon multiple charge-discharge cycles. For example, Tadanga et al[2]. observed a 10th cycle discharge capacity of ~52% of the initial capacity, Bramnik et al.[3] reported ~59% and Wolfenstine et al.[4] reported ~53% capacity retention (This has been attributed to irreversible structural changes or amorphization of the charged, low–lithium content material and electrolyte degradation.

Our more recent work[5] reported improved capacity retention using substitutionally-modified $LiCoPO_4$ in conjunction with an electrolyte additive[6] that improves the electrolyte stability at high voltage. Our related work[7] compared the electronic structure of $LiFePO_4$ and $LiCoPO_4$ through spectroscopic and electronic methods in order to understand the differences in electrochemical performance.

Herein we will present results showing further improvements to the electrochemical performance of substituted $LiCoPO_4$ including higher discharge capacity and improved cycle life. We will discuss alternative scalable synthesis methods, substitutional chemistry of $LiCoPO_4$ and performance enhancements that result from reformulating the electrolyte.

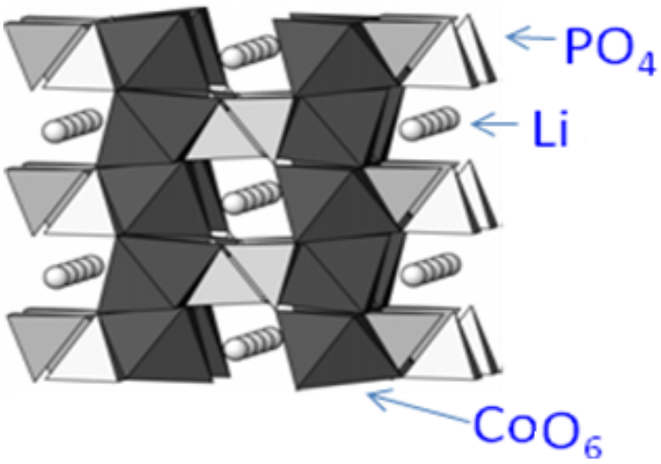

Figure 1: Structure of $LiCoPO_4$

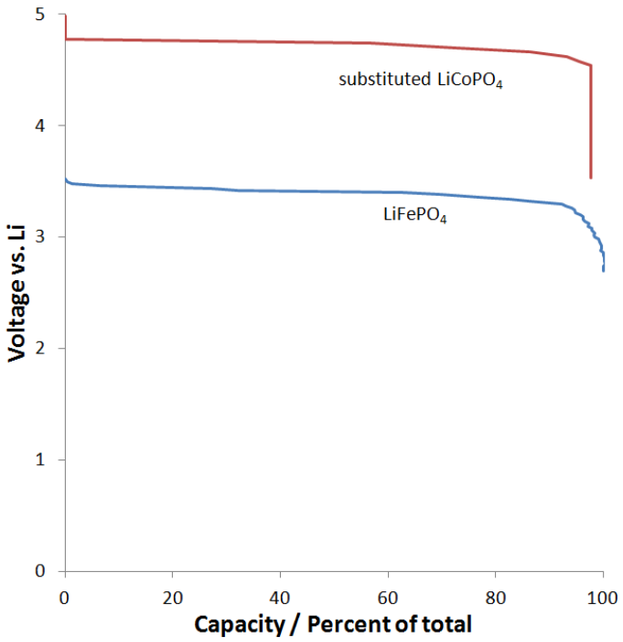

Figure 2. Illustration of the voltage difference between $LiFePO_4$ and substituted $LiCoPO_4$.

References

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