Lithium Titanium Phosphate/Pt Composites with Enhanced Li^+ Ion Conductivity

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Current liquid electrolytes used in lithium ion batteries (LIB) could potentially be replaced by solid state electrolytes which could improve the electrochemical, mechanical and thermal properties of LIB's [1]. While potential solid state lithium ion conductors are numerous in the literature most do not possess the ionic conductivity needed for LIB's. One such example is lithium titanium phosphate (LTP) which is a solid state ionic conductor of the NASICON family [2]. Pure LTP shows weak ionic conductivity [3]. However, cation substitution at lattice sites, producing composites with other conducting materials and selective doping have been shown to increase the ionic conductivity of the LTP phase [4], [5]. In the present study LTP/Pt composites were produced where Pt forms a conducting interstitial binder phase with the LTP crystals. Among other benefits, this immediately eliminated challenges associated with the individual interactions of the LTP grains. Initial SEM-EDS measurements showed that the composites are comprised of bulk FCC Pt that is supported on the surfaces of the LTP crystals. Synchrotron PDF and laboratory based *in situ* PXRD measurements showed that increasing Pt content does not alter the phase composition of the composites. Furthermore, processing of the composites into dense pellets did also not alter the phase distribution while DTA measurements showed that the composites are stable with respect to their phase behaviour over broad temperature ranges. Additionally, PDF analysis showed that increases in density and volume could suggest possible Pt substitution at LTP lattice sites. Analogous EIS measurements showed that these observations correlate with an increase in Li^+ ion conductivity of the LTP/Pt composites. A summary of the data obtained with structural and electrochemical characterization of these composites will be presented.

References

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