PhD report Juhi (Warsaw University of Technology)

Review of Thesis provided by Laurence Hardwick, University of Liverpool, UK

The thesis entitled "Design and Characterization of CsPbCl3 Perovskite-Based Anodes and Artificial SEI in Lithium Batteries" by Juhi submitted to the Warsaw University of Technology.

The thesis is divided into three chapters, of which one chapters present original results and analysis. Chapter 1 provides background and past work on Li-ion and Li metal batteries and the challenges for increasing capacity and cycle life. Metal halide perovskites (the focus of the thesis) are introduced with past examples provided on present state of art using this class of materials and their advantages and disadvantages.

In chapter 2 detailed experimental details are provided. Instrumentation and methods are explained in sufficient detail, such as the synthesis of the material investigated in the thesis: "CsPbCl3", fabrication of electrodes, cells and electrochemical testing procedures (galvanostatic, CV, EIS). Main characterisation methods where SEM, XRD and XPS. Instructions on how the experiment was run, but no introduction of the underlying principles of the methods were provided.

The sole results chapter (Chapter 3) present the investigation of CsPbCl3. It is not fully clear why only a single metal halide perovskite was selected for study. Where there attempts to synthesis other metal halide perovskites? Maybe ones without lead (Pb) which would not be used in a Li-ion cell due to its toxicity and added complications to recycling processes. It would be useful to add a separate chapter to report on this aspect if that was the case.

CsPbCl3 is investigated as an active electrode material and as a coating layer for Li metal to improve the stripping and plating of lithium metal. The coating was demonstrated at appreciable current densities to make a noticeable difference in the stability of the cell and this seems to be one of the main key outcomes from the thesis work. Aspects of this chapter have been included in a publication from the candidate (as first author) highlighting that the work presented in the thesis chapter is of publishable quality.

XPS was used to understand how the material changes during lithiation and delithaitation and at the interface of lithium metal. The XPS analysis was done to a good

standard, and it is good to see the candidate try to understand the reaction mechanism of the material.

The Li/Cu cell investigation was well carried out using preconditioning cycles to determine columbic efficiency in the different systems.

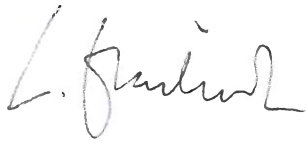
The candidate could have investigated or discussed the possibility of testing other electrolyte with additives to investigate the combined effect of CsPbCl3 and additive on the SEI stability.

Overall, the data, analysis and presentation of the scientific data in this chapter is to a very high standard.

There does not seem to be a separate conclusion chapter summarising all the main conclusions and learnings from the thesis, only a short statement at end of chapter 3 with a short statement of future work.

The thesis demonstrates a high standard of academic English for a PhD submission, with only minor language issues that do not obscure meaning.

Overall, this thesis represents a well carried out contribution to the field of Li-ion battery research and meets the threshold for carrying out novel research. However, it should be noted that the number or volume of new results collected over a 3/3.5 year PhD project is lower than for a typical chemistry PhD thesis in the UK where maybe three distinct research chapters are presented, as opposed to one here that focuses on the use of CsPbCl3 in both Li-ion and Li metal cells. As mentioned earlier in the report there may have been good reasons why only one results chapter was included, in that other aspects were attempted but not as fully developed, or synthesis of alternative materials were unsuccessful.



Laurence Hardwick, Liverpool, 16th January 2026