CHAPTER 5

CONCLUSION

5.1 Conclusion

The 3D printed PUA GPEs with different $LiClO_4$ concentrations have been successfully fabricated via stereolithography technique. The effects of increasing salt concentrations towards the GPEs' ionic conductivity, molecular functional group, morphology, transport number, thermal characteristics were investigated and the correlation between the results were studied. The highest conductivity achieved by 3D printed PUA GPEs was 1.24×10^{-3} S cm^{-1} at 10 wt.% $LiClO_4$ on par with previous studies. The further addition of $LiClO_4$ beyond 10 wt.% showed a decreasing ionic conductivity pattern. The same patterns were seen for the free ion percentage in FTIR deconvolution and FWHM values in XRD analysis which explained and supported the conductivity values achieved by 3D printed PUA GPEs. Furthermore, the addition of salt into the 3D printed GPEs system has changed the amorphous phase of the GPEs which can be seen through the changes of hump in XRD results and the shift of T_g values to lower temperature. Besides, the changes in surface morphology and shifts in absorption FTIR band of GPEs indicated there was structural rearrangement of polymer chain that leads to Li^+ cation transportation. The band shift of N-H, C=O and C-O-C functional groups in FTIR absorption studies occurred because of the complexation between $LiClO_4$ and SLA PUA photopolymer. The conductivity of 3D printed PUA GPEs was mainly contributed by ionic charges as the it exhibited high TNM value. Finally, the optimum 3D printed PUA GPEs-$LiClO_4$ composition (10wt.%) was

successfully printed into three complex 3D structures GPEs which indicated the 3D printing printability of optimum composition into 3D structure electrolyte.

Regarding the results obtained, PUA is a suitable polymer to be paired with 3D printing SLA method for GPEs fabrication as it showed high conductivity and comparable characteristics compared to the previous studies. With the integration of SLA into the fabrication process, it would be a stepping stone for the advancement of GPEs to maximize the performance especially through GPEs structure adjustment.

5.2 Recommendations for future studies

As the project completed, there are several recommendations that can be done in future project:

1. Use glovebox while preparing the sample and testing the sample to prevent the moisture being absorbed by the sample due to hygroscopic nature of lithium salt in the GPEs. The moisture could lead to the inconsistence result obtained especially for the EIS.
2. Investigate the effect of SLA UV exposure in the printing process on the GPEs performance. The SLA UV exposure used in this research was recommended exposure from the printer manufacturer.
3. Add suitable instruments that can verify the dimension and type of pores to further support the explanations in the SEM results.