CHAPTER VIII
CONCLUSIONS AND RECOMMENDATIONS

8.1 Conclusions

Our approach in this research can be contributed to the improvement of overall properties of high internal phase emulsion polymeric foam (polyHIPE) with using in two main application including adsorbent for CO_2 gas adsorption and scaffold in tissue engineering application. All experimental works can be concluded as follows;

For adsorbent in support of CO_2 gas adsorption, three-component surfactant system, Soxhlet extraction technique, and also addition of organoclay as inorganic reinforcement were successfully applied in order to improve surface area, mechanical properties and adsorption capacity as well. Poly(Divinylbenzene)polyHIPE prepared from a single surfactant (Span80; S80), two different systems of three-component surfactants (S20M and S80M), with and without toluene as porogenic solvent were carried out. After polymerization of the continuous phase, the porous materials with interconnected pores were obtained. Morphology and surface properties of the two different materials prepared from three-component surfactant systems (S20M and S80M) gave a relatively similar behavior. The highest surface area of poly(DVB)polyHIPE was achieved when material was further subjected to Soxhlet extraction process. The optimum Soxhlet extraction time to achieve the highest surface area with the best mechanical properties for both S20M and S80M systems was around 6–12 hours. Further improvement of polyHIPE were carried out by using three types of organoclay derived from Na-bentonite i.e. HPCH, MOD and AC-MOD, that could be utilized as inorganic reinforcement. The incorporation of organoclay into poly(DVB)polyHIPE foams caused an improvement of both mechanical properties and surface area of resulting poly(DVB)polyHIPE foams. In addition, the results also showed that poly(DVB)polyHIPE nanocomposite foams became a good adsorbent for CO_2 gas adsorption by exhibiting the higher CO_2 adsorption capacity than the neat poly(DVB)polyHIPE foam. This could be due to the ability of organoclay to adsorb such gas into silicate layered lead to improve the adsorption of CO_2 gas of the obtained polyHIPE foam. Moreover, the effectiveness of organoclay, that improved overall properties of the obtained polyHIPE foam including high surface area, degradation temperature and the highest mechanical properties was observed at loading of 5 wt.%.

Besides poly(DVB)polyHIPE for using as an adsorbent for CO_2 gas adsorption process, poly(S/EGDMA)polyHIPE foam scaffold, which has 3D, highly porous with small interconnectivity was fabricated. The DBD plasma surface modification using atmospheric ambient air as a process gas was successfully used to enhance the hydrophilic properties of the poly(S/EGDMA)polyHIPE foam surface as well as to improve the interaction between the living cells and the polyHIPE substrate. It can be concluded from this study that the utilization of surface modification technique via atmospheric pressure plasma treatment lead to increase the efficiency of cell attachment and proliferation of the L929 fibroblast-like cells to the poly(S/EGDMA)polyHIPE porous foam.

8.2 Recommendations

Although the poly(DVB)polyHIPE porous foam was prepared successfully and could be used as an adsorbent for CO_2 gas adsorption process, the other toxic gases such as SO_2, and NO_x may be applicable. The future work should study the capability and also selectivity itself of polyHIPE for different gases in support of more information and industrial application. For further improvement in gas adsorption properties, polysulfone based polyHIPE foam may be an interesting alternative.