

CHAPTER IV

RESULTS AND DISCUSSION

4.1 Physical Property of Poly(S/DVB) polyHIPE and Poly(S/EGDMA) PolyHIPE

Poly(S/DVB) polyHIPE and Poly(S/EGDMA) polyHIPE have been successfully produced by the polymerization via high internal phase emulsion technique. SEM images are shown in Figure 14. The phase morphology shows open cell structures, have a narrow size distribution, have interconnected pores (window) on wall which represent the characteristic of polyHIPE materials. Poly(S/DVB) polyHIPE, the pores have approximately 88 μm in diameter and BET surface area were 8.585 m^2/g , this suggests that there was mesopores in polyHIPE structure. A similar observe in poly(S/EGDMA) polyHIPE, the pores have approximately 61 μm in diameter and BET surface area were 71.207 m^2/g , thus mesopores in polyHIPE structure. As a result of highly interconnected macroporous materials may be useful for water absorption. Poly(S/DVB) polyHIPE failed in brittle manner than Poly(S/EGDMA) polyHIPE, with compressive strength 6.334 and 3.711 MPa respectively. The decrease in compressive strength is relatively comonomer independent, increasing with crosslink density.

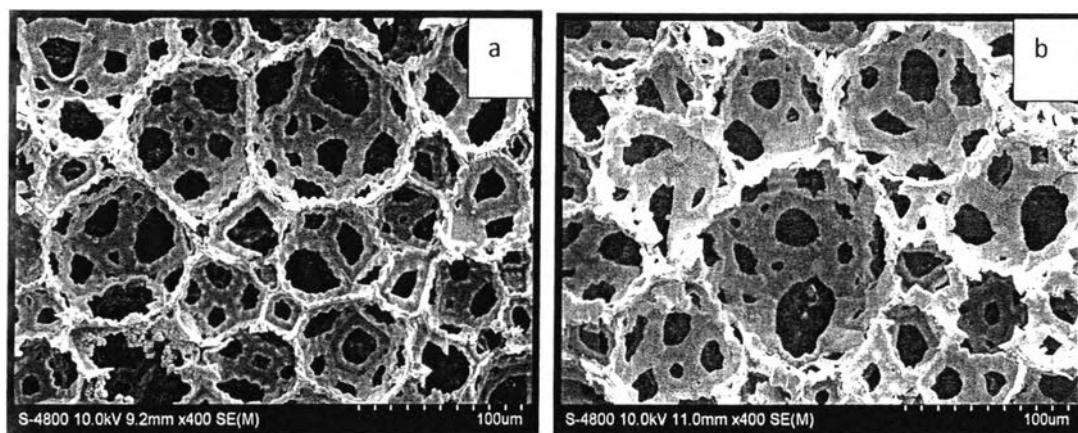


Figure 4.1 SEM micrographs of polyHIPE; a) poly(S/DVB)HIPEs
b) poly(S/EGDMA)HIPEs with magnification $\times 400$.

Table 4.1 Physical property of polyHIPE

Physical property	Sample	
	Poly(S/DVB)polyHIPE	Poly(S/EGDMA)polyHIP E
Surface area (m ² /g)	8.585	71.207
Pore diameter (nm)	88	61
Compressive strength (Mpa)	6.334	3.711

4.2 Determination of PEM Layers on Poly(S/DVB) PolyHIPE

The layer-by-layer technique was an easy method to modify surface. PDAD-PSS was selected as a primary layer of polyelectrolyte pair, solutions are transparency, thus there is no reflection of UV-Vis spectroscopy. The secondary of PDAA-Humic was introduced to finally functionalization, brown solution. The effected of the number of layers coated on poly(S/DVB) polyHIPE are seen in Figure 15, there is an increase in absorbance of UV-Vis spectroscopy with increasing the number of layer, reflecting in linear relation (Fig. 16). The photograph of poly(S/DVB) polyHIPE with PDAD-Humic acid illustrated in Figure 17, the they shown the homogenous coating. The color of Humic was investigated with different number of bi-layers, increasing in color as number of bi-layer increased. These results confirm the layer-by-layer were completely process.

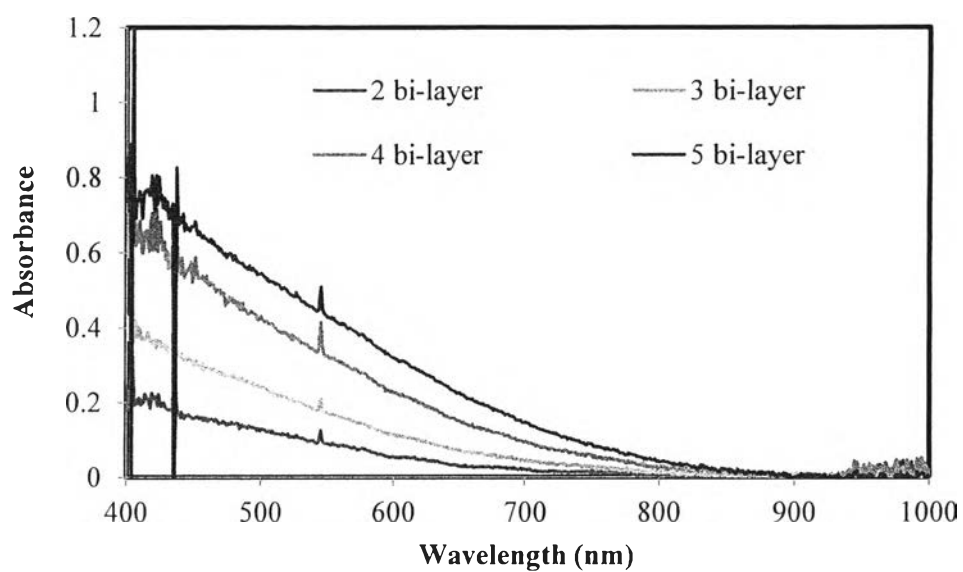


Figure 4.2 UV-Vis spectrum of poly(S/DVB) polyHIPE modified surface with PDAD-Humic acid.

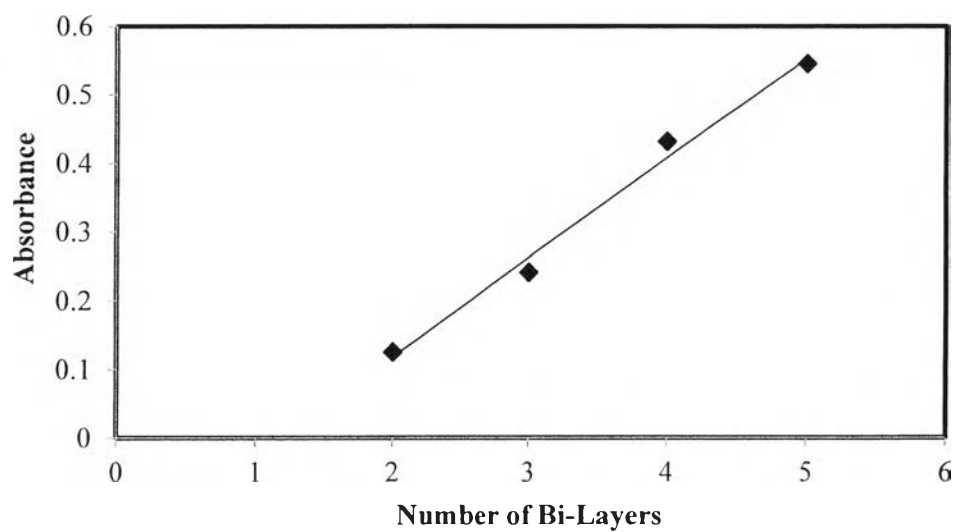


Figure 4.3 Absorbance as a function of the number of bi-layers for PDAD-Humic acid multilayer deposit on poly(S/DVB) polyHIPE.

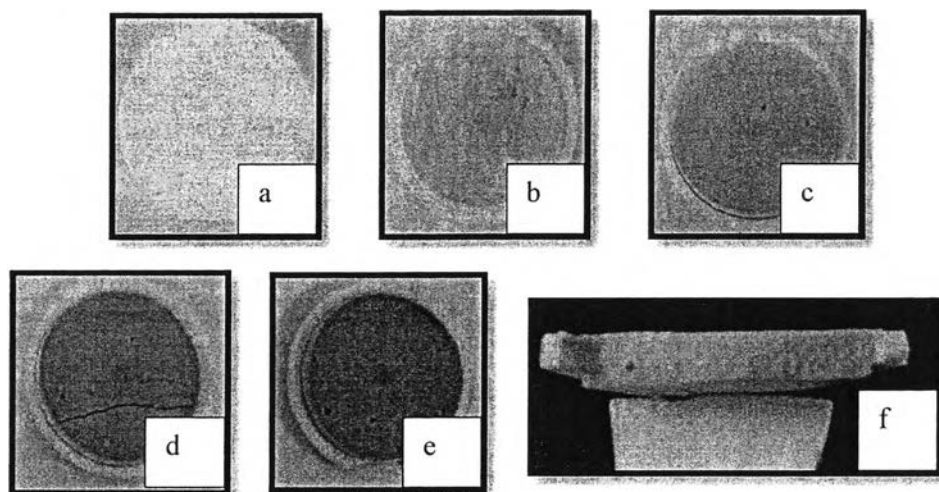


Figure 4.4 Photograph of poly(S/DVB) polyHIPE modified surface with PDAD-Humic acid. a) no coating, b) 2 bi-layer, c) 3 bi-layer, d) 4 bi-layer, e) 5 bi-layer and f) cross-section.

4.3 Effect of the Number of PEM Layers on Wettability of Poly(S/DVB) PolyHIPE

The near spherical water droplet on polyHIPE surface in Fig.19 (a contact angle approximate 120°) exhibits the polyHIPE's hydrophobicity. The benzene groups surrounding the polymer backbone made poly(S/DVB) polyHIPE extremely hydrophobic. The water does not wet the surface of poly(S/DVB) polyHIPE, therefore water was not absorbed into polyHIPE. The modified surface on poly(S/DVB) polyHIPE with PDAD-PSS enhanced the wetting of polymer surface (a contact angle approximate 90°). Due to the hydrophilic of poly(S/DVB) polyHIPE surface was occurred by the addition of $-\text{SO}_3$ groups attached to the polymer surface. The droplet of water can spread on the surface, thus the contact angle decreased while the number of layers increased (as shown in Fig. 18). Because the water droplet easily spreaded and penetrated onto hydrophilic surface of polyHIPE. These results illustrate that a hydrophilic can be produced from a highly hydrophobic porous polymers.

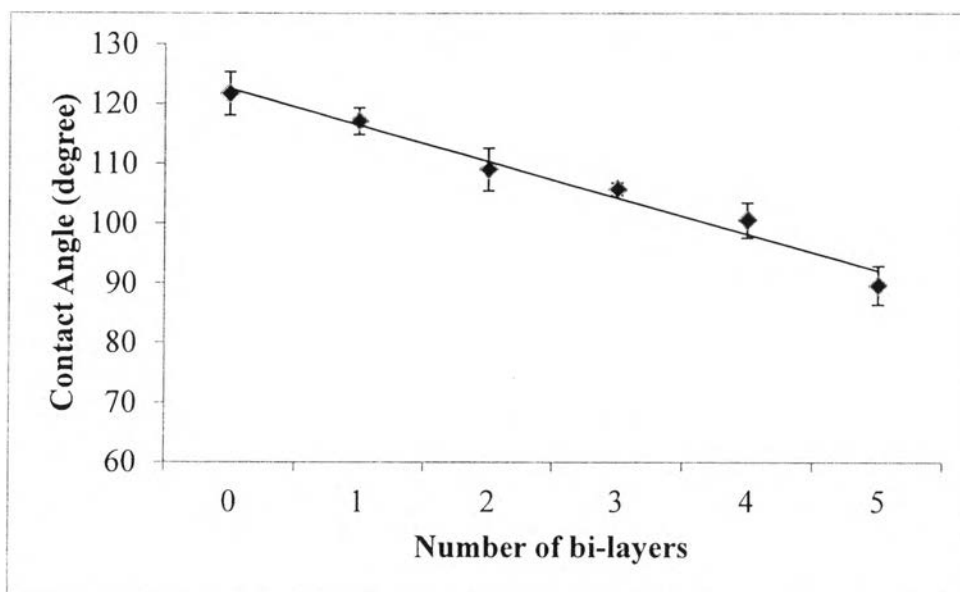


Figure 4.5 Contact angle as a function of the number of bi-layers for PDAD-PSS multilayer deposit on poly(S/DVB) polyHIPE.

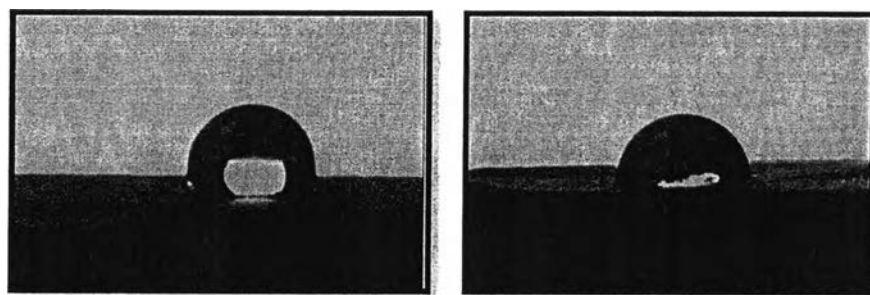


Figure 4.6 Photographs of water droplets on polyHIPE : a) no coating and b) with coating 5 bi-layers of PDAD-PSS.

4.4 Effect of PEM Coating on Water Absorption Capacity

The coating polymers used in this study are same in hydrophilicity but different structures. PSS and ALG are complex structure than PAA so water hard to attach with hydrophilic site then low water absorption capacity. Figure 20 represents the structure of coating polymers PDAD-PAA and also represents the ionic

interactions occurring on the two polyelectrolytes, which is ionic cross-linking between nitrogen of PDAD and COO^- of PAA.

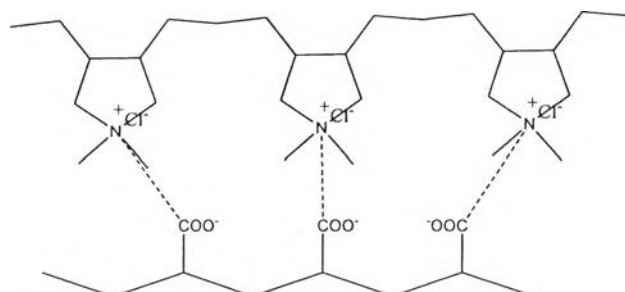


Figure 4.7 Formation of polyelectrolyte complex with ionic interaction.

The variation of water absorption capacity with time for poly(S/DVB) polyHIPE modified surface with PDAD-PAA, PDAD-PSS and CTS-ALG are shown in Figure 21. The result in modifying surface with PDAD-PAA was highest water absorption capacity (approximately 8) due to the more hydrophilic than PDAD-PSS and CTS-ALG.

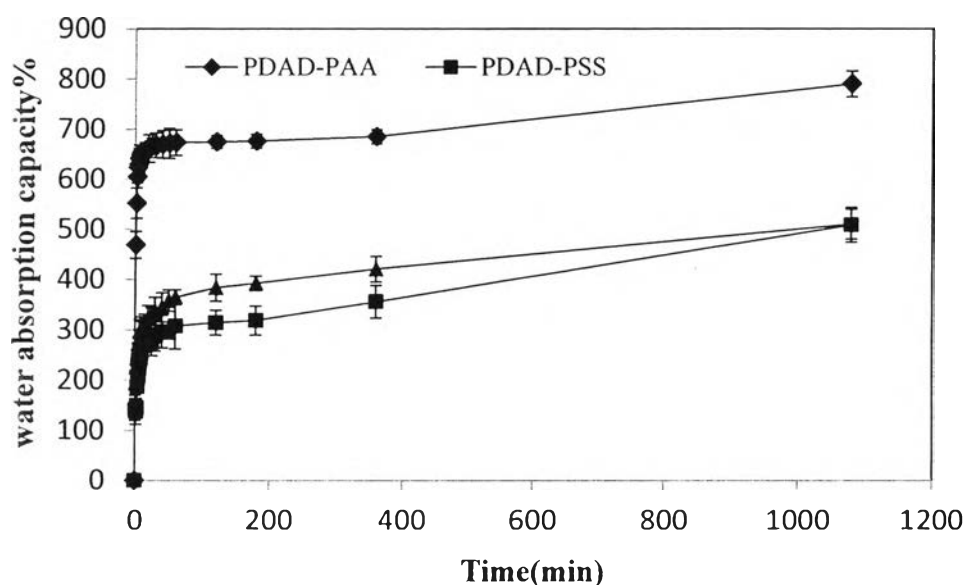


Figure 4.8 Water absorption capacities as a function of time for poly(S/DVB) polyHIPE modified surface with PDAD-PAA, PDAD-PSS and CTS-ALG.

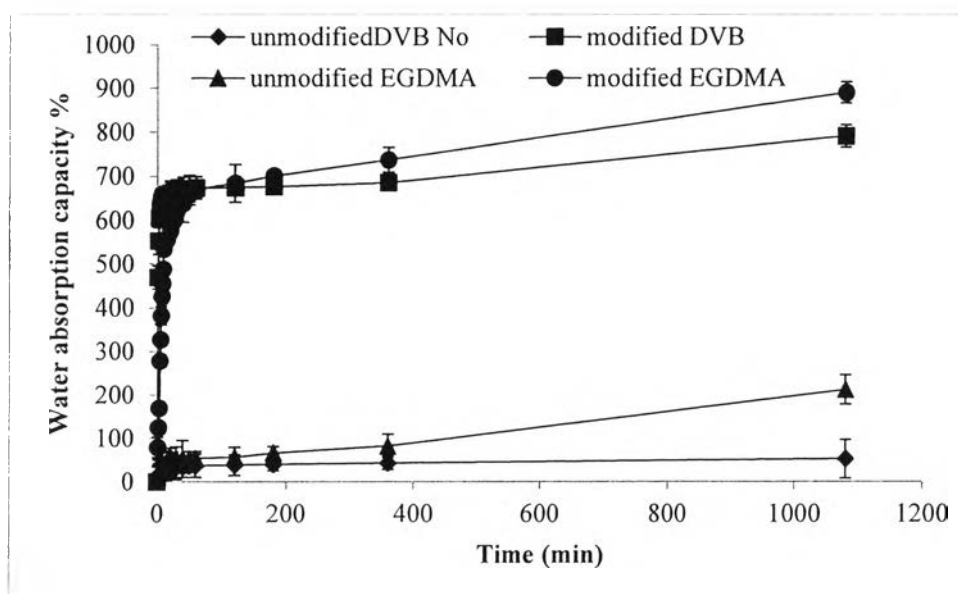


Figure 4.9 Water absorption capacity as a function of time for poly(S/DVB) polyHIPE and poly(S/EGDMA) polyHIPE modified surface with PDAD-PAA.

The monomer examined in this study, DVB and EGDMA, are different structure. DVB is composed of benzene ring which is hydrophobic. EGDMA has a hydrophilic group (-COO-) which serves as a water-attracting site in polyHIPE. In order to study the behavior of water absorption of polyHIPE we extended 7 days to confirmed equilibrium or maximum water uptake. (Annatoly) The variation of water absorption capacity with time for poly(S/DVB) polyHIPE and poly(S/EGDMA) polyHIPE are shown in Figure 22. There is a rapid increase in water absorption at the first period then slowly increase and close to steady state. Poly(S/EGDMA) polyHIPE with PDAD-PAA coating on surface contains the highest water absorption capacity, approximately 9. Poly(S/DVB) polyHIPE exhibits low water absorption capacity, approximately 0.5. These result reflects the hydrophobicity of poly(S/DVB) polyHIPE and hydrophilicity of Poly(S/DVB) polyHIPE and PDAA-PAA coating, thus high water absorption capacity.