HIGH POROSITY POLYETHERKETONEKETONE

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Polyetherketoneketone (PEKK) is a semi-crystalline thermoplastic polymer from polyaryletherketones family, with outstanding mechanical properties (4.5 GPa Young's modulus), high melting point (+337°C), low flammability and high chemical resistance. PEKK cannot be dissolved in the most of the common solvents but at the temperature between glass transition and melting point, PEKK can be dissolved in high boiling aprotic solvents such as 4-phehylphenol, diphenyl sulfone and chlorophenols [1]. Thermally induced phase separation (TIPS) is one of the methods how porous PEKK can be produced. TIPS is based on the phenomenon that the polymer solubility in a solvent at high and low temperature is different [2]. For PEKK in 4-phelylphenol and 9-fluorenone mixture TIPS were used to obtaining the controllable porous structure. Porosity and pore morphology (SEM) were investigated.

In present work high-temperature thermostat with the active cooling system equipped with a 250 ml round-bottom glass vessel was used. To control the temperature inside the glass vessel, an external thermocouple was used. PEKK and solvent (4-phenylphenol or 9-fluorenone) were placed into a small glass vial, which placed into a glass vessel. Then, glass vessel was heated up until the PEKK solution became transparent. After that, the temperature was decreased at a various cooling rates. During the cooling process of PEKK solutions, when polymer solution reached its cloud point, the transparent liquid became turbid and solid-liquid demixing was observed. After that, samples were purified by Soxhlet extraction with ethanol. To define the pore morphology of the resulting porous polymers scanning electron microscopy was used.

Different cooling rates were investigated. After SEM pictures were analyzed, we define that decreasing of cooling rate possessed resulting porous PEKK to the more homogeneous structure. Moreover, solvent nature has an influence on resulting polymer pores morphology. When 4-phenol was used, pores has a small size and pores directional structure was observed. With 9-fluorenone pores, morphology was more homogeneous. TIPS method was successfully used to produce high- porosity PEKK, with controllable porous structure.

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[1] KennCorwin H Gardner, Benjamin S Hsiao, Robert R Matheson, Barbara A Wood, Polymer, Volume 33, 1992, , Issue 12, Pages 2483-2495

[2] P. van de Witte 1, P.J. Dijkstra, J.W.A. van den Berg, J. Feijen, Journal of Membrane Science, Volume 117, Issues 1–2, 21 August 1996, Pages 1-31