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The Phase Behavior in Supercritical Carbon Dioxide of Hyperbranched Copolymers with Architectural Variations

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Abstract

Hyperbranched polymers (HBPs) have been known and extensively investigated for over two decades. However, there are still areas that need to be explored. Recently, much effort has been placed in developing drug delivery systems based on macromolecules of three-dimensional structure. This paper describes the synthesis of hyperbranched copolyesters of 2,2-bis(hydroxymethyl)propionic acid (bis-MPA) containing small amounts (5 or 10%) of chain extending units of various lengths and their phase behavior in supercritical carbon dioxide ($scCO_2$) after modification with trifluoroacetic anhydride. The structure of the copolyesters was confirmed with ^{1}H and ^{13}C NMR, FTIR spectroscopies and MALDI-TOF mass spectrometry. The phase behavior of the polymers in supercritical carbon dioxide was explored as a function of concentration and temperature. It was shown that polymers containing 5% (in respect to bis-MPA) of chain extending units of the moderate length (5-hydroxypentanoate or 6-hydroxyhexanoate) exhibited the lowest phase transition parameters in supercritical carbon dioxide.

Keywords: hyperbranched polymer, polyester, phase behavior, supercritical carbon dioxide

Introduction