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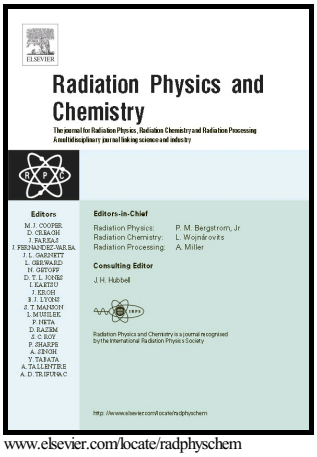

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Radiation-Induced Controlled Polymerization of Acrylic Acid by RAFT and RAFT-MADIX Methods in Protic Solvents

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Abstract

The kinetic investigation of one-pot synthesis of poly(acrylic acid) (PAA) prepared via gamma radiation induced controlled polymerization was reported. PAA homopolymers were prepared by Reversible Addition-Fragmentation Chain Transfer (RAFT) polymerization in the presence of trithiocarbonate-based chain transfer agent (CTA) 2-(Dodecylthiocarbonothioylthio)-2-methylpropionic acid (DDMAT) and also by Reversible Addition-Fragmentation/Macromolecular Design by Inter-change of Xanthates (RAFT/MADIX) polymerization in the presence of a xanthate based CTA O-ethyl-S-(1-methoxycarbonyl) ethyl dithiocarbonate (RA1). The polymerizations were performed at room temperature by the virtue of ionizing radiation. Protic solvents were used for the RAFT polymerization of AA considering environmental profits. The linear first-order kinetic plot, close control of molecular weight by the monomer/CTA molar ratio supported that the polymerization proceeds in a living fashion. The linear increase in molecular weight with conversion monitored by Size Exclusion Chromatography (SEC) is another proof of controlling of polymerization. [Monomer]/[RAFT] ratio and conversion was controlled to obtain PAA in the molecular weight range of 6900 – 35800 with narrow molecular weight distributions. Reaction kinetics and effect of the amount of RAFT agent were investigated in detail. Between two different types of CTA, trithiocarbonate based DDMAT was found to be more efficient in terms of low dispersity (Đ) and linear first-order kinetic behavior for the radiation induced controlled synthesis of PAA homopolymers.

Keywords: Poly(acrylic acid), Reversible Addition–Fragmentation Chain Transfer (RAFT), Reversible addition–fragmentation/macromolecular design by inter-change of xanthates (RAFT/MADIX), Gamma irradiation, Trithiocarbonate, Xanthate.