ROLE OF DISPERSED POLYMERIC NANOPARTICLES IN THE BULK POLYMERIZATION OF METHYL METHACRYLATE

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Many efforts have been made to investigate the role played by nanoparticles (NPs) during the preparation of polymer–matrix nanocomposites (PMNCs) through in situ polymerization.\(^1\)\(^2\) In this work,\(^3\) we proposed a methodology to investigate the effect of dispersed NPs on bulk polymerization of methyl methacrylate (MMA), based on DSC experiments and modeling of the bulk polymerization kinetics. As examples, we have applied it to polymeric NPs, polytetrafluoroethylene (PTFE) and polystyrene (PS), and compared the results with those from linear PMMA and cross-linked PMMA (cPMMA). The presence of dissolved linear PMMA enhances the MMA bulk polymerization kinetics, as if the system was prepolymerized at a conversion equal to the dissolved amount of the linear PMMA. The dispersed cPMMA also enhances the MMA polymerization kinetics, but the enhancement decreases as the cross-linker in the cPMMA increases. The PTFE NPs behave like (inert) dead volume, while the PS NPs do enhance the MMA polymerization kinetics due to their slight swelling in MMA. Therefore, we can conclude that dispersed non-swelling polymeric NPs behave like inert dead volume, and swellable polymeric NPs enhance the MMA bulk polymerization kinetics and the enhancement extent increases as the swelling extent increases. Moreover, we have examined the microstructure of the final PMNCs in the presence of different NPs through cryogenic cracking and CryoSEM imaging. When the cPMMA NPs or PTFE NPs are introduced during the MMA bulk polymerization, we have observed grain structures in PMMA. In particular, each PTFE NP is located in the center of a grain and the boundary is pulled out during the sample fracturing, indicating that the formation of the microstructure is related to the dispersed PTFE NPs.

References: