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Influence of Annealing on the Mechanical αc-Relaxation of Isotactic-Polypropylene: A Study from the Intermediate Phase Perspective

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Abstract : In this work, the influence of annealing on the mechanical αc-relaxation behavior of isotactic polypropylene (iPP) was investigated. The results suggest that the mechanical αc-relaxation behavior depends strongly on the confinement force on the polymer chains in the intermediate phase and the thickness of the intermediate phase. After quenching at 10°C, abundant crystallites with a wide size distribution are formed. The polymer chains in the intermediate phase are constrained by the crystallites, giving rise to one broad αc-relaxation peak. With an annealing temperature between 60°C~105°C, imperfect lamellae melting releases part of the constraint force, which reduces the conformational ordering of the polymer chains neighboring the amorphous phase. Consequently, two separate αc-relaxation peaks could be observed which are labeled as αc1-relaxation and αc2-relaxation. αc1-relaxation and αc2-relaxation describe the relaxation behavior of polymer chains in the region close to the amorphous phase and the crystalline phase, respectively. Both relaxation peaks shift to a higher temperature as annealing temperature increases. With an annealing temperature higher than 105°C, the new crystalline phase is formed in the intermediate phase, which enhances the constraint force on the polymer chains. αc1-relaxation peak is broadened obviously and its position shifts to a higher temperature as annealing temperature increases. Moreover, αc2-relaxation is undetectable because that the polymer chains in the region between the initial crystalline phase and the newly formed crystalline phase are strongly confined.

Keywords : annealing, αc-relaxation, isotactic-polypropylene, intermediate phase
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