

Effect of mechanical energy on the intra- and inter-molecular interactions of amorphous polymers

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Mechanical energy can affect not only macroscopic properties (e.g. transparency, mechanical strength) but also molecular level interactions. However, understanding on the effect of mechanical energy to the macromolecules is scarce. In this work, the mechanical energy provided by ball mill found to influence both intra- and inter-molecular interactions. At the early stage of ball milling, the molecular weight degraded by direct scission of the covalent C-C bond in main chain. As the milling time increases, the scission of main chain tend to be hindered, while intermolecular properties (e.g. segmental mobility, chain slip energy) varied. The results can be accounted for the energetic competition between the intra- and inter-molecular energy as a function of molecular weight. In addition, the critical molecular weight value accessible by ball milling can also be explained by the overlapping molecular weight concept. The explanation can be the foundation for elaborating molecular degradation mechanism of the amorphous polymers by the mechanical energy.