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Molecular motion confinement after physical aging[1] XIAOLIANG WANG, QIANG GU, Nanjing University, PINGCHUAN SUN, Nankai University, CHAO TENG, DONGSHAN ZHOU, GI XUE, Nanjing University — As a structural relaxation of the glassy state toward the metastable equilibrium amorphous state, physical aging plays a very important role in the design, manufacture, and use of glassy polymer materials and devices. Combined with several solid state NMR techniques, we first illuminate the mechanism of structure relaxation of polystyrene at molecular level. T_1 relaxation of ^{1}H and ^{13}C showed no difference between aged and quenched sample. The amplitude and geometry of aromatic ring motion was detected by two-dimensional separated local field experiments (PISEMA). We found the amount of 180 degree flip motion decreased after aging, while asymmetry parameter increased. And the wobbling amplitude of both 180 degree flip and static motion decreased after aging. The results showed physical aging make the aromatic side rings stacking closer and tighter. However no change of phase happened at scale larger than 20 nm. This result well explained that why physical aging make polymer material brittle while most of other characterizing methods could not show the difference before and after aging.

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