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Dynamics Studies of UV Pretreated Polyethylene Terephthalate Using Solid-State NMR Spectroscopy

Polyethylene terephthalate (PET) is one of the most widely used plastics worldwide and is applied, *i.a.*, as packaging material in the food industry.[1] Like many polymers, PET is susceptible to photochemical degradation and absorbs in the ultraviolet (UV) range.[2]

As already known, UV irradiation of PET leads to shorter molecular chains and thus to a higher number of carboxyl end groups,[3,4] which was confirmed here with attenuated total reflection Fourier-transform infrared spectroscopy (ATR-FTIR). To clarify whether this pretreatment method also affects the chain dynamics of PET, we used centerband-only detection of exchange (CODEX) and rotating-frame spin-lattice relaxation times for protons ($T1\rho(1H)$) to investigate PET chain dynamics on various timescales at ambient temperature (30 °C) as well as close to its glass transition temperature (70 °C) before and after UV illumination. CODEX is a one-dimensional exchange experiment which allows for characterization of slow segmental reorientations on the millisecond to second timescale,[5] whereas $T1\rho(1H)$ times provide information about molecular dynamics on the microsecond to millisecond timescale.[6]

Both MAS NMR experiments revealed an increased mobility of the PET chains at 70 °C compared to 30 °C. Furthermore, $T1\rho(1H)$ experiments showed slower motions after UV treatment at both temperatures and CODEX experiments indicated lower mobility for the UV illuminated sample at 70 °C.

References:

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