CPP 60: Polymer and Molecular Dynamics I

Time: Wednesday 17:00–17:30 Location: C 264

CPP 60.1 Wed 17:00 C 264

Molecular Mobility and Physical Aging of Polymers with Intrinsic Microporosity (PIMs) as Revealed by Dielectric Spectroscopy — •Huajie Yin, Nora Konnertz, Martin Böhning, and Andreas Schönhals — Bundesanstalt für Materialforschung und -prüfung, Unter den Eichen 87, 12205 Berlin, Germany

Polymeric membranes represent a cost- and energy- efficient solution for gas separation. Recently polymers of intrinsic microporosity (PIMs) outperform many conventional dense polymers by high permeability and appealing selectivity. However, this novel class of glassy polymers are prone to pronounced physical aging. The initial microporous structures approach a denser state via local chain rearrangements, leading to a dramatic reduction in the gas permeability. For the first time, dielectric spectroscopy with state-of-the-art high-resolution analyzers was employed to investigate the molecular mobility and physical aging of various representative PIMs with a systematic change in chain rigidity. The dielectric behavior of the polymeric films was measured by isothermal frequency scans during the different heating cycles in a broad temperature range. Structural relaxation of the films was found during the measurements. Multiple dielectric processes following Arrhenius behavior were observed for the investigated polymers. Moreover, they all showed conductivity in the glassy state. The significant increase in the conductivity with increasing temperature is explained in terms of the formation of local intermolecular agglomerated structures due to interaction of π-electrons in aromatic moieties of the polymer backbone.

CPP 60.2 Wed 17:15 C 264

First Clear-cut Experimental Evidence for A Glass Transition in Polymers of Intrinsic Microporosity (PIMs) — •Huajie Yin[1], Yeong Zen Chua[2], Bin Yang[2], Christoph Schick[2], Martin Böhning[1], and Andreas Schönhals[1] — [1]Bundesanstalt für Materialforschung und -prüfung (BAM), Unter den Eichen 87, 12205 Berlin, Germany — [2]University of Rostock, Institute of Physics and Competence Center CALOR, Albert-Einstein-Str. 23-24, 18059 Rostock, Germany

Polymers with intrinsic microporosity (PIMs) represent a novel innovative class of materials with great potential in several applications from high-performance gas separation membranes to electronic devices. Microporosity with BET surface areas $>$ 700 m2/g is due to their rigid structure resulting in limited molecular mobility. Up to now no glass transition temperature (Tg) could be detected before degradation. Therefore, it is important to clarify whether PIMs undergo a glass transition. Decoupling the time scales responsible for the glass transition and decomposition is a reliable strategy. This was achieved by employing fast scanning calorimetry (FSC) based on a chip sensor, which is capable to heat and cool a small amount of sample with extremely high heating/cooling rate of many thousands of Kelvin per second. For the first time, Tg values of two archetypal representatives of PIMs: PIM-1 and PIM-EA-TB were determined. FSC provides clear-cut experimental evidence of the glass transition of PIM-1 with a Tg of 442 °C and PIM-EA-TB with a Tg of 404 °C at a heating rate of 30,000 K/s.