1.10 Relaxation Processes in Main and Side Chain Polymers

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Relaxation processes in nonlinear optical polymers are of considerable interest for obtaining a better understanding of the long-term stability of potential devices fabricated from these materials. The poling induced orientational order of the nonlinear optical chromophores- a prerequisite for electro-optic activity in these systems - tends to relax with time and temperature. Best stability can be expected far below the glass transition where relaxation which involves large scale molecular motions within the polymers is hindered.

We investigated the relaxation mechanisms of our newly developed side and main chain polymers above and below the glass transition by observing the decay of the second-harmonic light, and by dielectric relaxation and differential scanning calorimetry measurements. All results are in good qualitative agreement with the predictions of a phenomenological model of the glass transition. From data measured over the period of more than one year, one can expect temporal stability of the poled polymers up to 100 years at temperatures 100˚ below the glass transition. The main and side chain systems show a very similar relaxation behavior, indicating that the side chain chromophres are strongly coupled to the polymer backbone as in the main chain system.

Further work is in progress to find chromophores with improved thermal stability. They would allow us to increase the glass transition of our polymer systems to even higher temperatures. The resulting long term stability would then fulfill most of the requirements of current device specifications.