POLING OF EO POLYMERS - CORONA DISCHARGE PROCESS OPTIMIZATION.

E. Nitišs*, E. Titavs, M. Rutkis, O. Vilītis

Institute of Solid State physics, University of Latvia, Latvia
** Corresponding author: edgars.nitiss@cfi.lu.lv*

An increasing interest has been devoted to new nonlinear optical (**NLO**) active organic materials due to their low cost, easy processability and potential applications as organic optical components. Such materials must possess large second-order nonlinear coefficients which can be obtained by electric field poling. For maximal possible NLO efficiency one must achieve the highest polar order in the system maintaining the chromophore structure, concentration and thin film optical properties. One of the most popular poling techniques at the moment is poling with corona discharge. For polymer poling purposes the corona triode device seems very attractive due to the fact that one can have good estimation of poling field, low probability of electrical breakdown in the sample, etc. We have built a computer controlled corona triode device which allows us to capture current-voltage characteristics of the system as well as perform EO polymer poling at constant grid potential or sample current. The poling efficiency can depend on multiple parameters as shown previously [1-3]. To optimize these parameters one has to develop a reproducible corona poling process. It can be done by means of cutting out uncertainties in surface charging ionic flux generation by corona needle – control grid system. Upon to our experience there are two important things to be done. First of all - an ambient air in corona chamber should be replaced with nitrogen by a constant, very slow flow of gas through the system. In case of air the humidity alternates along with the environment conditions and therefore causes uncertainty in corona generated ionic composition and conductivity. Moreover, corona discharge in air creates large amount of ozone, which is highly reactive and in some cases could destroy NLO active chromophores in polymer. The second thing to be done in order to obtain constant ion flux on the grid (by number and speed of charged particles) is to keep constant corona needle to control grid potential. At these circumstances the grid to sample gap behaves almost ohmic and in the case of nitrogen gas filed system the gap resistance is not dependent on temperature. As a result, poling field over sample film can be estimated from grid potential and sample current measurements over large range of poling temperatures.

After fulfilling above mentioned conditions the poling efficiency can be optimized by altering poling temperature and control grid – sample system parameters, for instance – grid to sample distance and potential. In order to demonstrate difficulty of such optimization, results of corona poling of host – guest polymer films of PMMA with DMABI (10%wt) chromophore will be presented. The NLO coefficients were determined by Maker fringe technique. Desirable sample parameters after poling, such as high polar order (necessary condition NLO efficiency) and low light scattering, can be quite contradicting and therefore certain equilibrium of poling conditions should be found. As an example (see Figure 1), we can demonstrate that large sample currents (in order to achieve high poling potential) can cause formation of light scattering structures in poled area of sample.

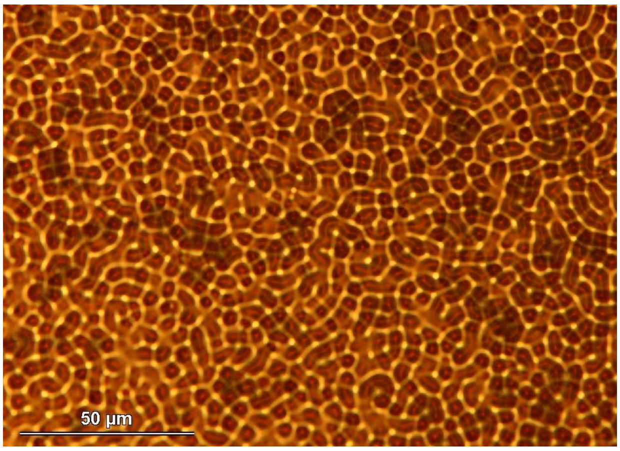

Figure 1. Optical microscope image of light scattering structures in the corona poled sample

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