Charging of Thin Polymer Electret Films in Corona Discharge

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A corona discharge is a self-sustainable electrical discharge occurring when a sufficiently high voltage is applied between asymmetric electrodes such as a point or a fine wire and a plate. The corona discharge is perfectly controllable and thus it can be easily used for charging electrets. The corona charging has the following advantages compared with other poling methods: (a) poling can be performed without deposited electrodes or with only one electrode, (b) higher fields can be achieved in corona poling than in the case of sandwich contact poling, and (c) thin films can be poled in spite of defects, because destructive breakdown phenomena are limited only to small sample areas [1].

By inserting a control grid between the corona electrode and the sample surface, the charging can be supplemented with simultaneous measuring the build-up and decay of the surface potential. The constant current corona triode is mainly applied as an experimental technique for characterizing three types of polymers: nonpolar, ferroelectric and with non-linear optical properties [1].

Non polar polymers of high electrical resistance such as Teflon, capable of storing space charge for a long period of time have been used for electret applications, e.g. microphones. Ferroelectric polymers form a class of electrets with highly ordered and disordered phases coexisting in one material. To induce ferroelectric orientation of dipoles, the polymers such as PVDF, P(VDF-TrFE), P(VDF-TFE) were subjected to a poling procedure usually performed in a corona setup. In the case of a constant current corona triode it has been found that the initial poling and switching processes in ferroelectric polymers consisted of three stages, each one corresponding to a definite part of the sample potential - time curve. Polymers for nonlinear optics attracted interest because of the strong nonlinearity of molecular chromophores as guests, side groups, or main-chain segments. The technique most commonly used for NLO polymers is corona poling performed near the glass transition temperature. We believe that corona poling under well controlled conditions may contribute in optimizing the poling processes of NLO polymers in order to obtain second order nonlinear activity.

Due to its versatility and flexibility, corona charging allows for the optimization of the poling procedure for a given electret. If excess surface or/and volume charge is to eliminated or neutralized, one can easily perform virtual short circuiting in a corona triode by changing the corona polarity with simultaneous grounding of the control grid of the corona triode.

1. J. A. Giacometti, S. Fedosov, M. M. Costa *Brazil. J. of Physics*, vol. 29, 1999, p. 269-279.