1.14 XPS Study of the Electron Beam Damage on Organic Thin Films

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Reflection high energy electron diffraction (RHEED) and low energy electron diffraction (LEED) have been developed for in-situ inspection of the crystalline quality of the substrates or monitoring of the thin film growth in a molecular beam epitaxy (MBE) process. They have been used primarily for the study of the growth of inorganic materials. With the application of the MBE growth process to different organic materials, there have been attempts to use the same analytical tools also for these materials. Successful electron diffraction experiments (limited to a short observation time) have been reported for a few types of organic thin films, primarily for PTCDA and different phtalocyanides.

Our attempts to obtain a diffraction image of one of the nonlinear optical materials (MNBA, COANP, PNP) ended in vain. Furthermore, the material was destroyed by electron beam irradiation. In order to understand why only some organic materials withstand the interaction with an electron beam, we systematically investigated the occured damage. The experiments consisted of the e-beam irradiation of an MNBA thin film, with different electron currents and energies, followed by the XPS (x-ray photoelectron spectroscopy) chemical analysis.

It has been found, that during the irradiation process the aromatic rings and bonds between them remain practically intact while the attached donor and acceptor groups represent weak points. After a few hours of irradiation the acceptor groups were completely removed from the molecules as observed from the changes of the binding energy of the core level electrons as well as in the changes in the valence band structure. The electron diffraction experiments on nonlinear optical materials, which all have a donor-acceptor system, seems to be an extremely difficult task.