B PREFACE

The Nonlinear Optics Laboratory continued activities in the following fields:

- Molecular Crystals, Polymers and Langmuir-Blodgett Films
- Photorefractive Effects and Applications in Optical Parallel Processing
- Integrated Optics and Optical Frequency Conversion
- Organic and Inorganic Thin Films by Molecular Beam Epitaxy
- Investigation of Organic Molecules at Interfaces using Nonlinear Optics and Atomic Force Microscopy
- Magnetic Resonance Spectroscopy

Research in the field of molecular crystals, polymers and Langmuir-Blodgett films is currently focused on the development of novel organic materials which possess very large electro-optic and nonlinear-optical effects. Included in the activities of 1995 was the successful growth and investigation of ionic organic DAST crystals with sizes up to 20 x 20 x 6 mm^3. In addition, crystal and molecular engineering led to the first preparation of several new molecular crystals, including a new material with almost complete parallel alignement of its nonlinear optically active chromophores. Such an alignement is optimal for applications in electro-optics and the investigation of the physical properties was started by the end of 1995.

The investigation of the relaxation behaviour of nonlinear optic polyimide side chain polymers has been completed with a PhD thesis. A novel scaling law has been found, which allows a prediction of the stability and relaxation times as a function of both temperature and processing conditions. For the first time photorefractive effects have been found in two new organic crystals DANPH and DAST (full names are given in the next section). Together with COANP:TCNQ, in 1990, and MNBA, in 1993, we have discovered the photorefractive effect in four different organic crystals and,up to now, these are the only ones known to be photorefractive.

In 1995 we also produced, for the first time, photorefractive $KNbO_3$ crystals which show good photosensitivity in the near infrared (up to 1100 nm). In addition, even higher photorefractive sensitivities have been discovered in proton-implanted $KNbO_3$ waveguides. For the first time the wavelength range of photorefractive materials with good photosensitivity could be extended to the current telecommunication wavelengths (up to 1500 nm). Detailed investigations and applications of these unexpected results are presently under way and will be reported next year.

The preparation of ion-implanted waveguides in pure $KNbO_3$ can now be done reproducibly. In 1995 we concentrated our efforts on the improvement of our planar technology for producing low loss channel waveguides and on the build-up of several prototypes of blue or green all solid-state lasers using $KNbO_3$ crystals and waveguides. As the most remarkable result we have built up a 45 mW blue laser source (491 nm) using a MOPA-laser diode and a $KNbO_3$ waveguide and a tunable solid state laser (tuning range 431 nm - 438 nm) by sum-frequency generation of two laser diodes in $KNbO_3$.

The investigation of ferroelectric domains and organic molecules at interfaces using atomic force microscopic and nonlinear optical techniques also progressed in 1995. For the first time molecular resolution of a free floating Langmuir film on water could be demonstrated. Also, the width of a ferroelectric domain wall in tri-glycine sulfate could be resolved by atomic force microscopy to be smaller than 8 nm.

1995 was a special year for the nonlinear optics laboratory with many changes in the research program and the personnel. At the end of the year the two priority programs LESIT Module 8: "Dielectric Sensor Materials Technology" and Optique I: "Organic Thin Films for Nonlinear Optic, Electro-Optic and Photorefractive Applications" and at the end of 1994 the NFP 24 Program: "Local Investigation of Position and Orientation of Organic Molecules at Solid and Liquid Surfaces" came to an end. For this reason several group members were very active in submitting new research proposals to different organisations in order to allow the continuation of our research on a similar level. The completion of many projects had the consequence , that a recond number of five PhD theses were succesfully completed by members of our group in 1995.

These successful graduates are: Dr. T. Blasberg, Dr. M. Duelli, Dr. D. Fluck, Dr. G. Knöpfle and Dr. Ph. Prêtre. We thank all of these group members, and the postdoctoral fellows Dr. B. Grafström, Dr. St. Pfändler und Dr. G. Ross who completed their postdoctoral stay in our laboratory, and also F. Eng and A. Herrmann who completed their work as technicians in our group in 1995, for their excellent work in our laboratory and wish them all the best for their future careers. As already announced in last year's report three members of our group left our laboratory in 1995 to become Professors at other Universities:

Prof. Dr. Z. Sitar (North Carolina State University, Raleigh, USA)
Prof. Dr. D. Suter (Universität Dortmund, D)
Prof. Dr. M. Zgonik (University Ljubljana, SLO)

During 1995 we could welcome Dr. G. Montemezzani, Dr. I. Poberaj and Dr. Y. Tao as new postdoctoral fellows and M. Abplanalp, U. Gubler, Ch. Jeitziner, I. Liakatas and R. Ryf as new PhD students and I. Brüngger as a technician.

In the fall of 1995 Prof. P. Günter started his sabbatical as a visiting professor of the electrical engineering department at Stanford University.