Preface to the Second Edition

We want to thank all the people that have appreciated the work done on the first edition of the "Ferroelectric Crystals for Photonic Applications". The positive feedback that we encountered motivated us to update our book with a second edition. Three new chapters have been added some of the existing chapters have been updated.

The main attention to the enhancement of this new edition was focused on the applications.

The idea to write a book in the field of ferroelectric crystal arose from the consideration that during the last years, several groups all around the world in the field of engineering and characterization of ferroelectric crystals have published more than 400 papers. The motivation for such an intense research activity can be found during the 60ies, when the scientists realized that the ferroelectric crystal could have been efficiently used to generate new, unavailable frequencies, taking advantage of the freshly proposed birefringent phase-matching method. The synchronized rush for the development of novel coherent sources and for the discovery of the best-suited nonlinear crystals for mixing and generation had started. Consequently, the number of applications of ferroelectric crystals has enormously grown in the last years, especially based on the use of periodically poled structures (i.e., PPLN, PPLT, PPKTP or PPKTA) to quasi-phase-match optical interactions. A new generation of sources is finding increasing applications in various fields, including high sensitivity trace gas monitoring and advanced spectroscopic set-ups, thus replacing "old style" gas lasers like Argon-ion or dye lasers.

Moreover new micro-devices have been developed and built, based on domain-engineering processes, for telecom or sensing applications (filters, ring resonators, whispering gallery mode based sensing devices, etc.). Other interesting and emerging topics are growing rapidly, and one of the most promising is related to the possibility of fabricating structures on micrometre and/or nanometre scale in ferroelectric crystal in order to realize photonic band-gap devices. Several papers appeared on this subject presenting different fabrication approaches (i.e., e-beam processing, poling by AFM scanning and interference lithography, and subsequent electric poling). Many new configuration for photonics devices would became possible taking advantage of photonic band-gap related physics with two- and three-dimensional

geometries. The appeal of ferroelectric crystals for similar applications also arises from the additional properties they exhibit, e.g., electro-optic, piezoelectric, pyroelectric effects, with respect to other materials, thus making possible unique performances.

Simultaneously several papers appeared during the last years in the most authoritative journals, where new characterization methods have been developed and proposed to investigate the basic properties of ferroelectric crystals (optical microscopy, interferometry, scanning probe microscopy, X-ray diffraction, etc.). Specific methods and procedures have been designed and used to investigate the structures during the engineering process as well as after the fabrication and while operating into the photonic and optoelectronic devices.

The aim of the present volume is definitely to give an up-to-date source of information in this scientific and technological field of increasing interest and not covered yet by other books. The books gathers the latest achievements in the field of ferroelectric domain engineering and characterization at micron and nano scale dimensions and periods. The results obtained in the last years by the main scientific groups all over the world recognized as the most experts in this area are presented in this book, thus providing, we hope, a valid and precious overview on the last developments and moreover on the future innovative applications of those engineered materials in field of photonics, for scientists working in this area. For those reasons, the book is aimed at researchers and PhD students who wish to be introduced rapidly in the last achievements in the field of material processing and applications of ferroelectric materials.

The book is organized in 18 chapters grouped into three parts: *Fabrication*; *Characterization*; *Applications*. The first part focuses on the development of advanced methods for micro- and nano-scale engineering of ferroelectric crystals; the second one illustrates the most widely used techniques for the characterization of material and engineering related properties of the crystal. The last part provides an overview of the most important current and future applications of the new ferroelectric structure devices in the field of photonics, spectroscopy and electro-optics. We wish to thank Dr. Vito Pagliarulo (CNR-INO) for helping us in the process: his fruitful cooperation has been truly appreciated.

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