Preface to the Second Edition

In the first edition, I discussed physical principles for structural phase transitions with applications to representative crystals. Although published nearly 6 years ago, the subject matter is so fundamental in solid states and I am convinced that this book should be revised in a textbook form to introduce the principles beyond the traditional theory of ideal crystals.

Solid-state physics of perfect crystals is well established, and lattice imperfections are treated as minor perturbations. The basic theories are adequate for most problems in stable crystals, whereas in real systems, disrupted translational symmetry plays a fundamental role, as revealed particularly in spontaneous structural changes. In their monograph *Dynamical Theory of Crystal Lattices*, Born and Huang have pointed out that a long-wave excitation of the lattice is essential in anisotropic crystals under internal or external stresses, although their theory had never been tested until recent experiments where neutron scattering and magnetic resonance anomalies were interpreted with the long-wave approximation. Also, the timescale of observations is significant for slow processes during structural changes, whereas such a timescale is usually regarded as infinity in statistical mechanics, and the traditional theory has failed to explain transition anomalies. Although emphasized in the first edition, I have revised the whole text in the spirit of Born and Huang for logical introduction of these principles to structural phase transitions. Dealing with thermodynamics of stressed crystals, the content of this edition will hopefully be a supplement to their original treatise on lattice dynamics in light of new experimental evidence.

We realize that in practical crystals, a collective excitation plays a significant role in the ordering process in conjunction with lattice imperfections, being characterized by a propagating mode with the amplitude and phase. Such internal variables are essential for the thermodynamic description of crystals under stresses, for which I wish to establish the logical foundation, instead of a presumptive explanation.

Constituting a basic theme in this book, the collective motion of dynamical variables is mathematically a nonlinear problem, where the idea of *solitons* casts light on the concept of local fields, in expressing the intrinsic mechanism of distant order involved in the collective motion in a wide range of temperature. While rather primitive at the present stage, I believe that this method leads us in a correct direction for nonlinear processes, along which structural phase transitions can be elucidated in further detail. I have therefore spent a considerable number of pages to discuss the basic mathematics for nonlinear physics.

I thank Professor E. J. Samuelsen for correcting my error in the first edition regarding the discovery of the central peak.

Mississauga, Ontario M. Fujimoto
September 2003

http://www.springer.com/978-0-387-40716-6

The Physics of Structural Phase Transitions
Fujimoto, M.
2005, XIV, 278 p. 97 illus., Hardcover
ISBN: 978-0-387-40716-6