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Guglielmo Ventura · Mauro Perfetti

Thermal Properties of Solids at Room and Cryogenic Temperatures

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To Eva and other demons

Guglielmo Ventura

*If I were a metal, I would definitely say
that I am a heavy lanthanide.*

*When the temperature is lowered enough
with a powerful refrigerator (Guglielmo),
and a strong magnetic field is applied
(Roberta) my domains (Sergio, Antonella,
Sandro) cooperatively align themselves
to create a strong ferromagnet.*

*When another magnet (Eva) is sufficiently
near me, we can interact and cooperate
with other magnets (the LaMM staff) to
create an even stronger material*

Mauro Perfetti

Preface

This book addresses the needs of researchers in physics and chemistry, project engineers and students interested in cryogenics and thermal properties of matter. Using a musical analogy it is piano four hands, not a work for two different instruments. The book's three parts, each of which is devoted to a respective thermal property, are written with the same guiding philosophy: (1) to describe theories on the propagation of heat in solids in a format that is concise but sufficiently detailed to understand the three thermal phenomena; (2) to review the main experimental techniques with some examples taken from the literature; and (3) to present experimental data in the form of tables and graphs.

A rich bibliography is provided at the end of each chapter.

Scientists will be particularly interested in the measurements methods, which describe some important details in set-ups at cryogenic temperatures. In addition, data on the thermal properties of several materials at the low (4–300 K) and very low (<4 K) temperature range are provided at the end of each Part.

For *Project Engineers* data on the three thermal properties and the integrated data in the form of tables will offer an essential and time-saving resource.

Students will be provided with the basics for performing measurements at low temperatures, and with a general, concise guide to the theory involved, focusing on the most important formulas and concepts necessary for understanding the thermal properties of solids at low temperatures.

For the sake of conciseness, the words “materials solid at standard temperature and pressure (stp)” were omitted from the title. Of course any material will become solid when the temperature is lowered and/or pressure is increased: for example ${}^4\text{He}$ becomes solid below $T \approx 2 \text{ K}$ under a pressure $\geq 25 \text{ bar}$.

Only a few materials not solid at stp (e.g. noble gases) are examined, in Part I. Though data on these materials is often of considerable interest (consider e.g. the importance of solid nitrogen enthalpy), it would go beyond the scope of this book.

Guglielmo Ventura
Mauro Perfetti

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