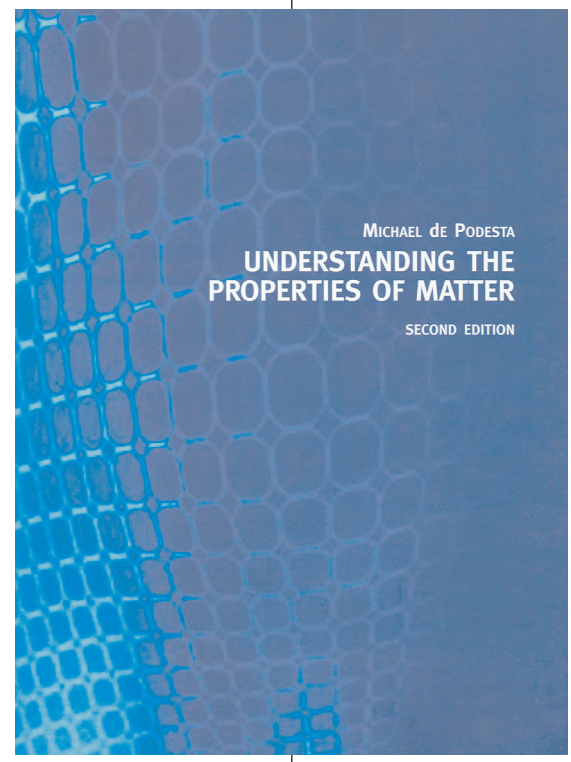
Understanding the Properties of Matter

Michael Podesta



Michael Podesta makes us familiar with what the properties of matter actually are. These are tabulated for hundreds or thousands of substances. He believes that unless we are familiar with the properties of simple matter it is impossible ever to say that you understand them. But understanding them, thats not only the title, but its the goal of the book. In the context of this book the author considers the following 'components' of the world, electrons, neutrons, and protons; and the electromagnetic field. The 'tools' used are classical mechanics and quantum mechanics, thermodynamics and statistical mechanics. The book often follows the principle of presenting a valuable amount of data for a certain topic, and subsequently the reader enters a section 'understanding the data' just presented. This way, the reader is motivated to think about explanations of the various effects by her/himself. M. Podesta hopes that the reader will discover (if she/he has not done so already) both the lovely certainties and stimulating mysteries that together make physicists enjoy their work, and continue to enjoy it as long as they can carry on with physics. It seems, that this goal has been achieved, and the book will be very useful for material scientists too.

Why did he write this book? This question is answered on the website of the book, www.physicsofmatter.com. Michael Podesta had an idea and thought 'Why not?'. A chance conversation with a publisher (Andrew Carrick) led him to actually write down a proposal for a book and as he wrote the proposal, the nature of what he intended to do became clearer. The key things he wanted to do were to write a book that was (a) accessible to non-specialists, (b) useful, and (c) had explanations in it. The way in which he wanted to achive these things was to first state as plainly as I could how 'matter' behaves. He thought that if this was introduced with as little theoretical content as possible then it would be very accessible. And then he could try to explain why matter had the properties it does. In its first draft, the book had the pairs of chapters as it does now, but the first chapter of each pair contained only data tables and graphs, with no theoretical introduction at all. The second chapter then referred back to these data chapters. Mike Holmes from the University of Central Lancashire suggested that some kind of introduction to each pair of chapters would make the book more accessible and useful, and that constantly referring back to data tables would drive readers around the bend. And so the current structure of the book evolved.

Why a second edition? The author is now thinking this was a mistake. He liked the first edition, and littered with mistakes as it was, at least most of them were not his ones! But when the chance of a second edition arose, he was still working as an academic at UCL, and had ambitious plans for what he could achieve. As a real working person and parent he has been stretched to his limit (and possibly beyond) in preparing the second edition. Using the web is an attempt to keep the text alive, and to get students involved in actively looking at data and analysing it.

The textbook is entertaining and innovative and fulfills the needs of undergraduate physicists and provides many resources needed by teachers of physics. The book takes a unique phenomenological approach, it discusses gases, solids, liquids and phase changes. The book offers theory and practice under one roof. It is a good book to read in paralell with General Physics or a refresher book for someone who already had these knowledge but became rusted. Each state of the matter is explained with a physical theory and than the experiments are introduced, explained and compared with the theory and formulas. However, complex fluids and non-newtonian rheology of complex fluids are beyond the scope of this book. After an overview of basic ideas and a reminder of the importance of measurement, the book considers in turn gases, solids, liquids and phase changes. It offers a preliminary examination of data on the properties of matter, and then raises and addresses a series of questions concerning the data. It is only in answering these questions that the theoretical approach to the properties of matter is adopted. The book contains extensive exam-

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ples and end-of-chapter exercises; this new edition has a new chapter composed entirely of extended exercises.

This text takes an unusual approach to the teaching of undergraduate level matter, materials and solid-state physics. The book adopts a "here is some theory; this is what happens in the real world; lets develop a theory and see how it agrees with the experimental data" approach. This second edition takes the approach even further with additional web-based material including datasets to download, computer programs to simulate experiments and self assessment questions for each chapter, all of which make the book both student and teacher friendly.

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Bibliography
Michael Podesta
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Michael Podesta is currently a senior research scientist working on laser-based temperature measurement techniques at the UK's National Physical Laboratory. Previously he worked for 13 years as a lecturer in physics at Birkbeck College and University College London.

He is married a with two children and lives in harmony with nature, as the author says, in Teddington, to the west of London.