Mechanical Properties of Metals: Atomistic and Fractal Continuum Approaches

C W Lung, Norman H March

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The book is intended to describe the basic and newly developed elements of the physics of solids and materials science on mechanical properties of metals with as much continuity as is possible. Particular emphasis has been placed in atomistic and fractal approaches and continuum theory of dislocations is also introduced. Since the book is meant for the two main topics of progress in recent years, some interesting and important topics which have not been discussed or introduced are given in detail.For a long time, pair potentials were used very expensively in simulation studies. They can reproduce usefully total energies for many systems. But when one turns to elastic properties, fracture of surfaces, and the vacancy formation energy, deficiencies and limitations begin to emerge. These limitations of the simple pair potential approximation have been addressed by the development of empirical many-body potentials which is the major theme of our book.Over a decade or more, diverse scientists have recognized that many of the structures common in their experiments have a special kind of geometrical complexity. The key to this progress is the recognition that many random structures obey a symmetry that objects look the same on many different scales of observation. The concept of fractals was introduced by Mandelbrot and applied to fractures by himself and collaborators. Their work pointed to a correlation between toughness and the fractal dimension. Our interest is the fractal aspects of fractured surfaces. We will discuss more in our book.The strain field of a dislocation has a long range part and this part can be discussed rigorously from elasticity theory. Recent progress in elastic strain fields and dislocation mobility were made by Indenbom and Lothe. The elementary essentials will be introduced in our book.

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