

Preface to the first edition

The research area of spintronics, although under investigation for decades, is still frequently excluded from physics in school and even in university. Although the mathematical formalisms used to describe spintronic processes are not exactly simple, the basic concepts and applications can often be understood without them – and teaching these should be part of physics education. While some of the possible future applications, such as quantum computing, are still dreams of the future, other applications have been used for years now, for example, in our computers' hard disk read/write heads, and should thus be understood at least by physicists.

Our aim is to give you an insight into this emerging field of theoretical and experimental physics and to guide you from a basic understanding of processes related to spintronics to the recent applications and future possibilities opened by ongoing research. We tried to explain as detailed as possible the physical background for the related phenomena combined with the underlying mathematical equations, guiding you from basic physics to the state of the art in the difficult area of spintronics.

Further, this book will present an overview of new trends and research results, as well as ideas in spintronics, at the beginning of the twenty-first century. It is suitable for students, industrial laboratory workers, and for interested scientists who were once discouraged from the theoretical quantum formalism up to now.

Starting with a short description of the spin and mathematical possibilities to describe it, some fundamental physical effects are introduced, taking into account different materials and structures. Micromagnetic modeling is used to illustrate magnetic effects in the typically very small spintronics devices. Their description is extended to contact effects in diverse interface pairs, followed by transport processes in spintronics structures. After depicting real spintronics devices and applications, the influence of external physical factors on spintronics devices is examined. Finally, materials nowadays used in commercial applications are described in detail.

In general, the presentation here goes from some theoretical backgrounds to many applied topics, suited mainly for less experienced scientists and students who want to know more about this exciting topic in recent physics.

We wish you an inspiring reading and hope the fascination experienced by researchers working in the field of spintronics will kindle your interest in this topic, too.

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