

Preface

The idea of writing a book about ferromagnetic microwires and their multifunctional composites initiated after the Ph.D. work of Dr. Manh-Huong Phan on novel magnetic materials in 2006 and that of Dr. Faxiang Qin on composites containing ferromagnetic microwires in 2010. With three more years' continued exploration along this line of work, we felt ready to commit ourselves to such a task and the book proposal to Springer was accepted in 2013. It took us two furthermore years, with a lot of ups and downs, to put a full stop on the writing.

The subject of magnetic microwires and their composites is essentially of interdisciplinary nature, and it touches on multiple fields ranging from materials science and engineering, electrical, and mechanical engineering to physics and chemistry science. We structured the book in two major parts: microwires and their composites, and spared no effort in elaborating the fundamental structure–property relationship through detailed discussions of all types of factors influencing their magnetic and microwave properties. We then described the application potentials from an engineering perspective.

Owing to their exceptional giant magnetoimpedance (GMI) property, ferromagnetic microwires find themselves of great usefulness in high-performance sensor applications where the ultrahigh sensitivity is a distinct advantage over conventional sensors. Driven by such advantages, researchers have spent decades to investigate the fundamental GMI mechanisms and related phenomena in order to advance the design, fabrication, and modulation techniques. The advent of ferromagnetic microwire composites is a direct result of the pursuit of multifunctionality of a composite. Starting from combining electromagnetic characteristics to potentially monitoring the structural health of aerospace composite components, we have presented in the second half of the book, relevant field-tunable microwave behaviour of the composites together with associated fundamental and technical analyses. Subsequently, the readers will find a spectrum of intriguing microwave performance of microwire-based composites in microwave absorption and EMI shielding. Last but not least, we highlighted the most recent work on the so-called *metacomposites*, an emerging topic that we have intensively studied during the

course of writing the book, which is aimed at bridging conventional metamaterials with engineering composites.

The main purpose of the book is to provide a comprehensive knowledge about functional soft ferromagnetic microwires and their composites. The philosophy behind the selection of functional element and the architectural design of composite is expected to be useful for those endeavoured to develop special functional filler for particular composite with various targeted applications, such as medical diagnosis of different types of virus and microwave absorbers operating on different frequency bands. It is pitched at the level of postgraduate students and researchers who are working or having an interest in this exciting research field.

It has been a long, challenging but also fulfilling journey to write such a book, as it involves a wide range of subjects in which our knowledge and expertise are not fully reached. Despite of our enormous efforts in connecting the dots and making sense of each sentence, the book cannot be free from unclear parts. Constructive comments from the interested readers are most welcome to enable us to further improve the book in future editions.

We are indebted to our collaborators worldwide, including Prof. Larissa Panina, Prof. Christian Brosseau, Prof. Arcady Zhukov, Prof. Julia Gaonzalez, Prof. Hari Srikanth, Dr. Dimitry Makhnovskiy, Dr. Mihai Ipatov, Prof. Victorino Franco, Dr. Nikolay Pankratov, Dr. Slava Popov, Prof. Jie Tang, Prof. Lu-Chang Qin, Prof. Walther Schwarzacher, Dr. Geoff Hilton, Mr. Yang Luo, Dr. Huan Wang, Dr. Jingshun Liu, Prof. Jianfei Sun, and all those who have offered us their kind help without which the completion of this book would not be possible. Finally, we extend our great appreciation to Prof. Manuel Vazquez who has kindly agreed to write the Foreword with much generosity.

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