<<功能陶瓷的显微结构、性能与制备 >

图书基本信息

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前言

The functional ceramic materials （FCM） are potential for use in many electronicdevices such as optical waveguides, non-volatile dynamic random accessmemories, micromotors, microactuators, thin film capacitors, and pyroelectricinfrared detectors. FCM possesses unique properties like piezoelectricity,pyroelectricity, photoelectricity, photo-acoustic effect, photorefractive behavior,and non-linear optical activity that are closely depends closely on the commontheme of composition-preparation-structure-property relationships in the solid state,especially microstructures （grain, grain boundary and domain structures, etc.） andtheir dynamic response to mechanical, electrical and optical loads at nanometerscale. Thus it is very important to understand the physical phenomenologicalbehavior of ferroelectric structures and their dynamic evolution in nanoscalevolumes. This is the context that motivated the publication of this book. The aim of this book is to present recent advances in the fabrication process offunctional ceramic materials and their property study, particularly, in-depthobservation/analysis of microstructures using the custom-built scanning electronacoustic microscopy （SEAM）, acoustic and piezoresponse mode scanning probemicroscopy based on atomic force microscopy. Along with the generally acceptedconcepts and experimental results there are numerous applications of functionalceramics and devices in industry. We hope that this book will make the readersaware of tremendous developments in the field of microstructure characterizationand functional ceramic preparations.The first two chapters address fundamentals of microstructures in the functionalceramics. Chapter 1 presents the formation mechanism of microstructuresincluding grains, grain boundaries, pores, domain structures, and their correlationswith properties and processing for some typical ceramics like PLZT （leadlanthanum zirconate titanate） ceramics, PTC （positive temperature coefficient） ceramics, piezoelectric ceramics, ferroelectric ceramics, and so on. Chapter 2discusses grain boundary phenomena such as grain boundary segregation andmigration in the functional ceramics.

内容概要

Microstructure, Property and Processing of Functional Ceramics describes the preparation, property and local structure microscopy of functional ceramics. It covers functional ceramic fabrication processing, grain boundary phenomena and micro-, nanoscale structures characterizations including scanning electron acoustic microscopy, scanning probe acoustic microscopy and piezoresponse force microscopy. This book is intended for advanced undergraduates, graduates and researchers in the field of materials science, microelectronics, optoelectronics and microscopy. Qingrui Yin and Binghe Zhu both are professors at the Shanghai Institute of Ceramics, Chinese Academy of Sciences; Dr. Huarong Zeng is an associate professor at the Shanghai Institute of Ceramics, Chinese Academy of Sciences.

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章节摘录

插图：According to Petzow, all phase regions and flaws contained in structures wouldbe reflected in microstructures, which determine many properties of materials.According to Pask（1984）, microstructures should include sizes and distribution ofgrains and pores, phase composition and distribution, nature of grain boundaryand its defects and flaws, composition homogeneity as well as domain structures.Ceramics are materials derived from powdery raw materials through variousprocessing,and possess specific microstructures and properties. Thusmicrostructures comprehensively reflect previous processing, and bring specificproperties to materials. Microstructural analysis is also important for determiningphase diagrams, providing bases for property analysis, instructing modification onformulation, processing improvement, production rationalization, and failureanalysis. The following are several examples which further explain the importanceof microstructure analysis. Example 1: There was a newly built transformer substation in Shanghai. In avery hot summer the elevated temperature caused a dramatical rise of the oilpressure with a ceramic container, and gave a blast on it. Luckily, it happenedduring the trial run, otherwise it would probably have caused life threat and powershut down for a massive area. The microstructural analysis afterwards on thatceramic debris showed that the silica particle had sharp boundaries in thehigh-tension insulator ceramics, which provided evidences that silica particles didnot fully melt and react with feldspar and other glass flits during sintering whilethe boundaries of silica particle of normal insulating ceramics are corroded withglass phases. The microstructure demonstrated that the ceramic body had not beenfully sintered, thus it had low tensile strength and couldn't survival under high oilpressure.Example 2: At a PTC heater manufacturer in Cixi city of Zhejiang province,the ceramic pieces were not broken after voltage test, but cracked in a largeamount after packing and transportation, which caused a loss of hundreds ofthousands of ceramic pieces （0.65 Yuan/piece at that time）. In the analysis ofmicrostructure of PTC ceramics, abnormally grown grains of large sizes werefound. During the puncture testing, large grain would expand or contract alongaxis, which produced large residual stress and micro cracks. Thus the as sinteredceramic plates had normal strength, but became fragile and brittle after puncturetesting because of micro cracks. After discovering the cause of problem, someadditional additives were introduced to the composition to restrain the abnormalgrain growth, and the problem was solved （Zhu, Yao, Zhao, et al, 2001）.

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