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THIN FILM FERROELECTRIC MATERIALS AND DEVICES

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PREFACE

The past five years have witnessed some dramatic developments in the general area of ferroelectric thin films materials and devices. Ferroelectrics are not new materials by any stretch of imagination. Indeed, they have been known since the early part of this century and popular ferroelectric materials such as Barium Titanate have been in use since the second world war. In the late sixties and seventies, a considerable amount of research and development effort was made to create a solid state nonvolatile memory using ferroelectrics in a vary simple matrix-addressed scheme. These attempts failed primarily due to problems associated with either the materials or due to device architectures. The early eighties saw the advent of new materials processing approaches, such as sol-gel processing, that enabled researchers to fabricate sub-micron thin films of ferroelectric materials on a silicon substrate. These pioneering developments signaled the onset of a revival in the area of ferroelectric thin films, especially ferroelectric nonvolatile memories.

Research and development effort in ferroelectric materials and devices has now hit a feverish pitch. Many university laboratories, national laboratories and advanced R & D laboratories of large IC manufacturers are deeply involved in the pursuit of ferroelectric device technologies. Many companies worldwide are investing considerable manpower and resources into ferroelectric technologies. Some have already announced products ranging from embedded memories in micro-controllers, low density stand-alone memories, microwave circuit elements, and rf identification tags. There is now considerable optimism that ferroelectric devices and products will occupy a significant market-share in the new millennium.

In this fertile environment, we present this book as a compilation of research and development progress in two very important ferroelectric device technologies, namely ferroelectrics for Dynamic Random Access Memories (DRAM's) and Non-Volatile Ferroelectric Random Access Memories (NV-FRAM's). Given the pace of development and the broad scope of the general topic of ferroelectric materials, such a focused approach was deemed necessary. The primary focus of this book is to expound the materials and device aspects of these technologies. All the chapters have been written or co-written by leading players in this field. Therefore, each chapter provides a comprehensive treatment of a specific topic of relevance to these two technologies. We believe this book will be of great value to materials and device scientists, device and process engineers, students and postdoctoral associates. Furthermore, this should also serve as a rapid introduction for new entrants into this very exciting field.

R. Ramesh