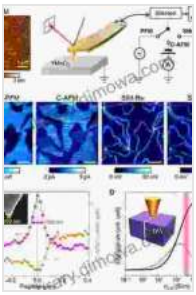
Scanning Probe Studies Of Structural And Functional Properties Of Ferroelectric



Scanning Probe Studies of Structural and Functional Properties of Ferroelectric Domains and Domain Walls (Springer Theses) by Rolando Zucchini

4 out of 5

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Ferroelectrics are a class of materials that exhibit spontaneous polarization, which can be reversed by an applied electric field. This unique property makes ferroelectrics essential for a wide range of applications, including sensors, actuators, and memory devices. Scanning probe microscopy (SPM) techniques provide powerful tools for studying the structural and functional properties of ferroelectrics at the nanoscale.

Scanning Probe Microscopy Techniques

SPM techniques use a sharp tip to scan the surface of a material, measuring various properties such as topography, electrical potential, and magnetic field. The most common SPM techniques used to study ferroelectrics are:

- **Piezoresponse force microscopy (PFM)** measures the local piezoelectric response of a material, which is directly related to its polarization. PFM can be used to image ferroelectric domains, domain walls, and other nanoscale features.
- **Scanning tunneling microscopy (STM)** measures the tunneling current between a sharp tip and a surface. STM can be used to image the surface topography of ferroelectrics and to study the electronic properties of domain walls.
- **Atomic force microscopy (AFM)** measures the force between a sharp tip and a surface. AFM can be used to image the surface topography of ferroelectrics and to study the mechanical properties of domain walls.

Structural Properties of Ferroelectrics

SPM techniques have been used to study the structural properties of ferroelectrics at the nanoscale. These studies have revealed that ferroelectrics typically have a domain structure, with each domain having a uniform polarization. The size and shape of the domains can vary depending on the material and the processing conditions.

SPM techniques have also been used to study the structure of domain walls in ferroelectrics. Domain walls are the boundaries between domains with different polarizations. The structure of domain walls can have a significant impact on the functional properties of ferroelectrics.

Functional Properties of Ferroelectrics

SPM techniques have been used to study the functional properties of ferroelectrics at the nanoscale. These studies have revealed that ferroelectrics exhibit a variety of functional properties, including:

- **Piezoelectricity** is the ability of a material to generate an electrical charge when it is subjected to a mechanical stress. Piezoelectricity is used in a variety of applications, including sensors, actuators, and energy harvesting devices.
- **Pyroelectricity** is the ability of a material to generate an electrical charge when it is subjected to a change in temperature. Pyroelectricity is used in a variety of applications, including infrared detectors and thermal imaging devices.
- **Ferroelectricity** is the ability of a material to retain its polarization even after the applied electric field is removed. Ferroelectricity is used in a variety of applications, including memory devices and capacitors.

SPM techniques provide powerful tools for studying the structural and functional properties of ferroelectrics at the nanoscale. These studies have led to a deeper understanding of the behavior of ferroelectrics and have enabled the development of new ferroelectric-based technologies.

References

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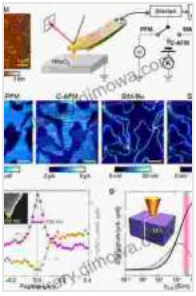

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