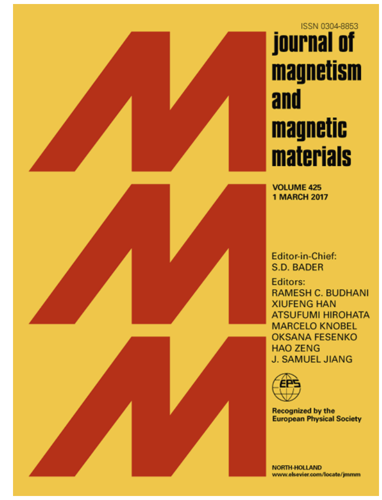
Accepted Manuscript




# Magnetic force microscopy studies in bulk polycrystalline iron

J. Abuthahir, Anish Kumar

PII: S0304-8853(17)30460-2
DOI: http://dx.doi.org/10.1016/j.jmmm.2017.06.107
Reference: MAGMA 62903

To appear in: *Journal of Magnetism and Magnetic Materials*

Received Date: 17 February 2017
Revised Date: 30 May 2017
Accepted Date: 24 June 2017

Please cite this article as: J. Abuthahir, A. Kumar, Magnetic force microscopy studies in bulk polycrystalline iron, *Journal of Magnetism and Magnetic Materials* (2017), doi: http://dx.doi.org/10.1016/j.jmmm.2017.06.107

# Magnetic force microscopy studies in bulk polycrystalline iron

J. Abuthahir and Anish Kumar*

Metallurgy and Materials Group, Indira Gandhi Centre for Atomic Research
HBNI, Kalpakkam-603102, Tamil Nadu, India
*E-mail: anish@igcar.gov.in

**Abstract**

The paper presents magnetic force microscopy (MFM) studies on the effect of crystallographic orientation and external magnetic field on magnetic microstructure in a bulk polycrystalline iron specimen. The magneto crystalline anisotropic effect on the domain structure is characterized with the support of electron backscatter diffraction study. The distinct variations in magnetic domain structure are observed based on the crystallographic orientation of the grain surface normal with respect to the cube axis i.e. the easy axis of magnetization. Further, the local magnetization behavior is studied *in-situ* by MFM in presence of external magnetic field in the range of -2000 to 2000 Oe. Various micro-magnetization phenomena such as reversible and irreversible domain wall movements, expansion and contraction of domains, Barkhausen jump, bowing of a pinned domain wall and nucleation of a spike domain are visualized. The respective changes in the magnetic microstructure are compared with the bulk magnetization obtained using vibrating sample magnetometer. Bowing of a domain wall, pinned at two points, upon application of magnetic field is used to estimate the domain wall energy density. The MFM studies in presence of external field applied in two perpendicular directions are used to reveal the influence of the crystalline anisotropy on the local micro-magnetization.

Keywords: Polycrystalline iron, MFM, magnetic domains, field dependent domain wall dynamics, domain wall energy density

## 1.0 INTRODUCTION

The magnetization behavior of a ferromagnetic material is governed by the characteristics of the magnetic domains and their dynamics. Magnetic domain imaging provides the most direct access to the effective magnetic properties from macro to nano scale for fundamental and application point of views [1, 2]. Various studies have been performed to directly visualize the magnetic domains and their dynamics in different materials using techniques such as magneto optical Kerr microscope (MOKE) [3-5], Lorentz electron microscope [6, 7],