Mapping of individual dislocations with dark field x-ray microscopy

We present an x-ray microscopy approach for mapping deeply embedded dislocations in three dimensions using a monochromatic beam with a low divergence. Magnified images are acquired by inserting an x-ray objective lens in the diffracted beam. The strain fields close to the core of dislocations give rise to scattering at angles where weak beam conditions are obtained. We derive analytical expressions for the image contrast. While the use of the objective implies an integration over two directions in reciprocal space, scanning an aperture in the back focal plane of the microscope allows a reciprocal space resolution of $DQ/Q < 5 \cdot 10^{-5}$ in all directions, ultimately enabling high precision mapping of lattice strain and tilt. We demonstrate the approach on three types of samples: a multi-scale study of a large diamond crystal in transmission, magnified section topography on a 140μm thick SrTiO$_3$ sample and a reflection study of misfit dislocations in a 120 nm thick BiFeO$_3$ film epitaxially grown on a thick substrate. With optimal contrast, the full width of half maximum of the dislocations lines are 200 nm, corresponding to the instrumental resolution of the microscope.
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): CiteScore 5.32 SJR 3.818 SNIP 3.874
Web of Science (2011): Impact factor 5.152
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 2.626 SNIP 2.056
Web of Science (2010): Impact factor 3.794
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 3.265 SNIP 2.108
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 2.005 SNIP 2.545
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.66 SNIP 3.441
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 2.164 SNIP 7.401
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 1.856 SNIP 2.377
Scopus rating (2004): SJR 1.651 SNIP 2.232
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 1.267 SNIP 1.65
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 2.144 SNIP 2.63
Scopus rating (2001): SJR 1.808 SNIP 2.194
Web of Science (2001): Indexed yes
Scopus rating (2000): SJR 1.151 SNIP 1.97
Web of Science (2000): Indexed yes
Scopus rating (1999): SJR 1.275 SNIP 1.468
Original language: English
Electronic versions:
dislocation_v23.pdf
ks5610.pdf
DOIs:
10.1107/S1600576718017302
Research output: Research - peer-review › Journal article – Annual report year: 2019