Magnetization of exsolution intergrowths of hematite and ilmenite: Mineral chemistry, phase relations, and magnetic properties of hemo-ilmenite ores with micron- to nanometer-scale lamellae from Allard Lake, Quebec - DTU Orbit (07/02/2019)

Magnetization of exsolution intergrowths of hematite and ilmenite: Mineral chemistry, phase relations, and magnetic properties of hemo-ilmenite ores with micron- to nanometer-scale lamellae from Allard Lake, Quebec

Hemo-ilmenite ores from Allard Lake, Quebec, were first studied over 50 years ago. Interest was renewed in these coarsely exsolved oxides, based on the theory of lamellar magnetism as an explanation for the high and stable natural remanent magnetizations (NRM$s$, 32 to 120 A/m, reported here. To understand the magnetism and evolution of the exsolution lamellae, the microstructures and nanostructures were studied using scanning electron microscopy and transmission electron microscopy (TEM), phase chemistry, and relations between mineral chemistry and the hematite-ilmenite phase diagram. Cycles of exsolution during slow cooling resulted in lamellae down to 1-2 nm thick. Combined electron microprobe, TEM, and X-ray diffraction (XRD) results indicate that hematite hosts reached a composition approximately ilmenite (Ilm) 14.4, and ilmenite hosts similar to Ilm 98. The bulk of the very stable NRM, which shows thermal unblocking similar to 595-620 degrees C, was acquired during final exsolution in the two-phase region canted antiferromagnetic $R(3)$ over bar c hematite + $R(3)$ over bar ilmenite. Hysteresis measurements show a very strong anisotropy, with a stronger coercivity normal to, than parallel to, the basal plane orientation of the lamellae. Magnetic saturation (Ms) values are up to 914 A/m, compared to 564 A/m predicted for a modally equivalent spin-canted hematite corrected for similar to 15% R-2+ TiO3 substitution. Low-temperature hysteresis, AC-susceptibility measurements, and Mossbauer results indicate a Neel temperature (TN) of the geikielite-substituted ilmenite at similar to 43 K. The low-temperature hysteresis and AC-susceptibility measurements also show a cluster-spin-glass-like transition near 20 K. Below TN of ilmenite an exchange bias occurs with a 40 mT shift at 10 K.

General information
State: Published
Organisations: Department of Physics
Contributors: McEnroe, S., Robinson, P., Langenhorst, F., Frandsen, C., Terry, M., Ballaran, T.
Publication date: 2007
Peer-reviewed: Yes

Publication information
Journal: Journal of Geophysical Research-solid Earth
Volume: 112
Issue number: B10
ISSN (Print): 0148-0227
Ratings:
BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 3.19 SJR 2.272 SNIP 1.475
Web of Science (2017): Impact factor 2.752
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 3.36 SJR 2.369 SNIP 1.558
Web of Science (2016): Impact factor 2.733
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 3.39 SJR 2.754 SNIP 1.605
Web of Science (2015): Impact factor 3.318
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 3.27 SJR 2.853 SNIP 1.757
Web of Science (2014): Impact factor 3.426
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 3.38 SJR 3.088 SNIP 1.809
Web of Science (2013): Impact factor 3.44
ISI indexed (2013): ISI indexed yes