American Mineralogist, Volume 94, pages 1111–1119, 2009

Quantitative microstructural characterization of natrojarosite scale formed during high-pressure acid leaching of lateritic nickel ore

Nicholas E. Timms,[1,*] Jian Li,[2] and Steven M. Reddy[1]

[1]The Institute for Geoscience Research (TIGeR), Department of Applied Geology, Curtin University of Technology, GPO Box U 1987, Perth, Western Australia 6845, Australia
[2]CSIRO Minerals (The Parker Centre), PO Box 7229, Karawara, Perth, Western Australia 6152, Australia

Abstract

The build up of scale inside autoclaves during high-pressure acid leaching of nickel laterite ore currently represents a significant industrial problem in processing plants. In this study, the crystallographic microstructure of natrojarosite scale developed on stirring rods inside a high-pressure acid leach autoclave are investigated using electron backscatter diffraction (EBSD). Backscatter electron imaging shows compositional layering of natrojarosite with dispersed minor iron oxide crystals and regularly spaced, parallel layer micro-porosity. Analysis of the scale by EBSD reveals that natrojarosite forms elongate grains with strong (0001) crystallographic preferred orientation with *c* axes aligned within the plane of the agitator substrate, consistent with unitaxial precipitation from a fluid. The natrojarosite grains contain a complex internal substructure of low-angle (<15°) boundaries that define elongate subgrains and accommodate up to 40° of systematic misorientation across single grains. Low-angle subgrain boundaries do not have simple twin relationships or low-index misorientation axes and are interpreted to have formed as a result of the propagation of crystal defects during growth rather than by syn-growth deformation due to shear stresses between viscous leachate slurry and the agitator inside the autoclave. The presence of extended defects in the scale microstructure has implications for the solubility and reactive stability of mineral processing waste as well as for the development of scale growth inhibitors.

Keywords: Scale, microstructure, defects, mineral, growth, jarosite