minerals

Supplementary Materails

Atomic Force Microscopy and Raman Microspectroscopy Investigations of the Leaching of Chalcopyrite (112) Surface

Gujie Qian [1,†], Christopher T. Gibson [1,2,3,†], Sarah Harmer-Bassell [1,2,3] and Allan Pring [1,*]

1. College of Science and Engineering, Flinders University, Bedford Park, SA 5042, Australia; gujie.qian@flinders.edu.au (G.Q.); christopher.gibson@flinders.edu.au (C.T.G.); sarah.harmer@flinders.edu.au (S.H.-B.)
2. Flinders Microscopy and Microanalysis, College of Science and Engineering, Flinders University, Bedford Park, SA 5042, Australia
3. Flinders Institute for Nanoscale Science and Technology, College of Science and Engineering, Flinders University, Bedford Park, SA 5042, Australia

† These authors contributed equally.
* Correspondence: allan.pring@flinders.edu.au; Tel.: +61-8-8201-5570

S1. XRD Analysis of Chalcopyrite

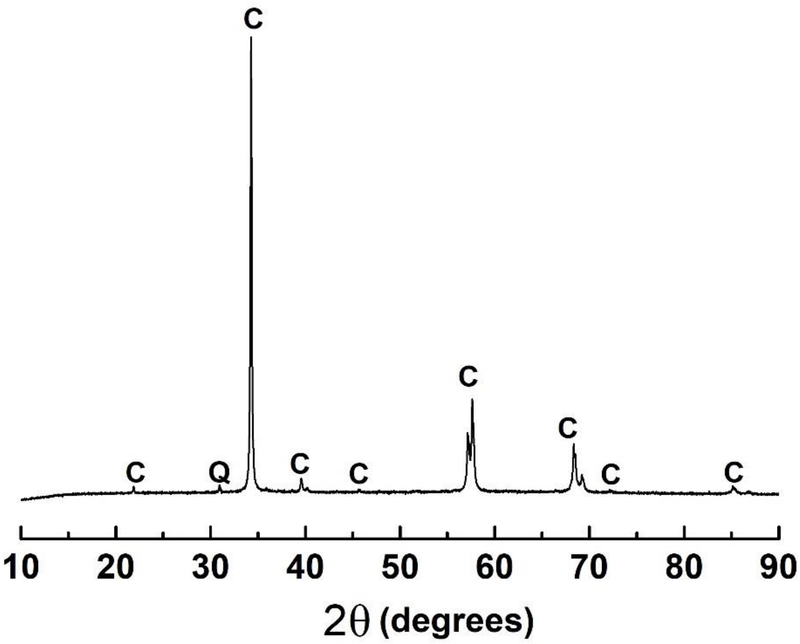

Figure S1. X-ray powder diffraction analysis of the chalcopyrite, showing the presence of very minor quartz impurity.

S2. Selection of the Same Areas for AFM Analysis

In our AFM experiments the exact same 5 × 5 µm area on each chalcopyrite sample was analysed using AFM after leaching treatments. Figure S2 shows a typical optical microscope image of a polished chalcopyrite sample surface where the AFM cantilever and polishing scratches, indicted by arrows in Figure S2, are clearly visible. When conducting AFM experiments, the AFM probe was initially positioned as close to the area of interest as possible using polishing scratches as markers. An initial 20×20 µm survey scan was often acquired at a scan rate of ~ 2 to 3 Hz, but was not always necessary, and then features within this image were used to locate the selected 5 × 5 µm image, which was imaged at the slower 1 Hz to optimise image quality. In this way, we could track changes in the sample surface topography on largely the same area between leaching treatments.

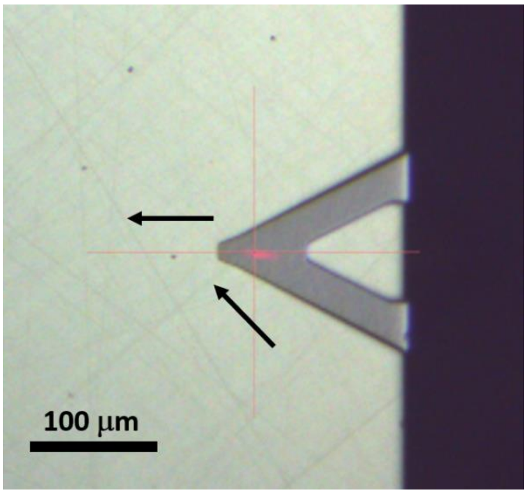

Figure S2. A typical optical microscope image of a polished chalcopyrite sample surface.

S3. Time-Resolved AFM Analysis

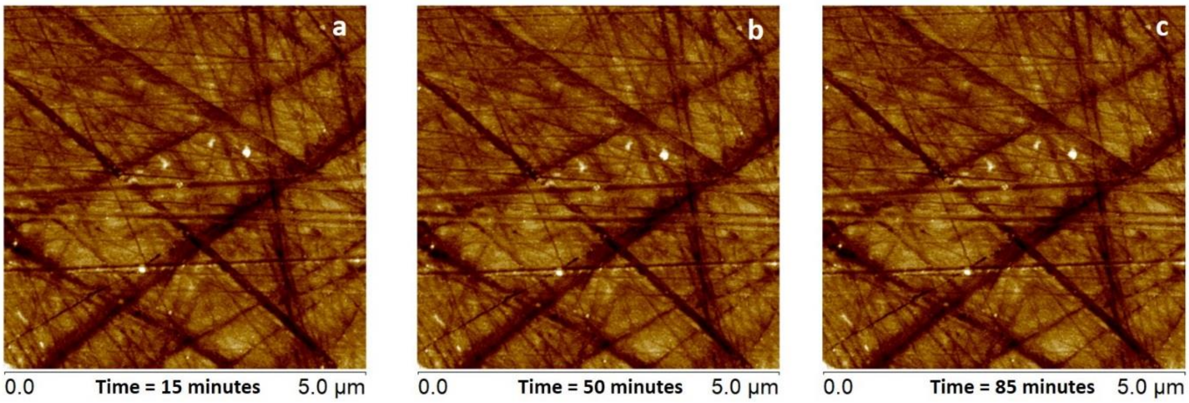

Figure S3. Time-resolved AFM images of a chalcopyrite (112) surface, showing no visible changes in topography within approximately 1.5 h.

Table S1. Surface roughnesses, Ra and Rq, derived from time-resolved AFM measurements.

Air Exposure Time (min)	15	50	85
RMS Roughness, R_q (nm)	4.32	4.31	4.35
Average Roughness, R_a (nm)	3.34	3.34	3.37

S4. Raman Analysis Using Different Laser Powers

The Raman spectra of a fresh chalcopyrite (112) surface were collected using different laser powers. Results showed that when the laser power was increased, peak 1 became less distinct and two additional bands appeared at around 474 and 692 cm^{-1} at the maximum laser power used (Figure S4). Optical images indicated the presence of a laser-damaged spot on the chalcopyrite surface after laser irradiation at the maximum power used.

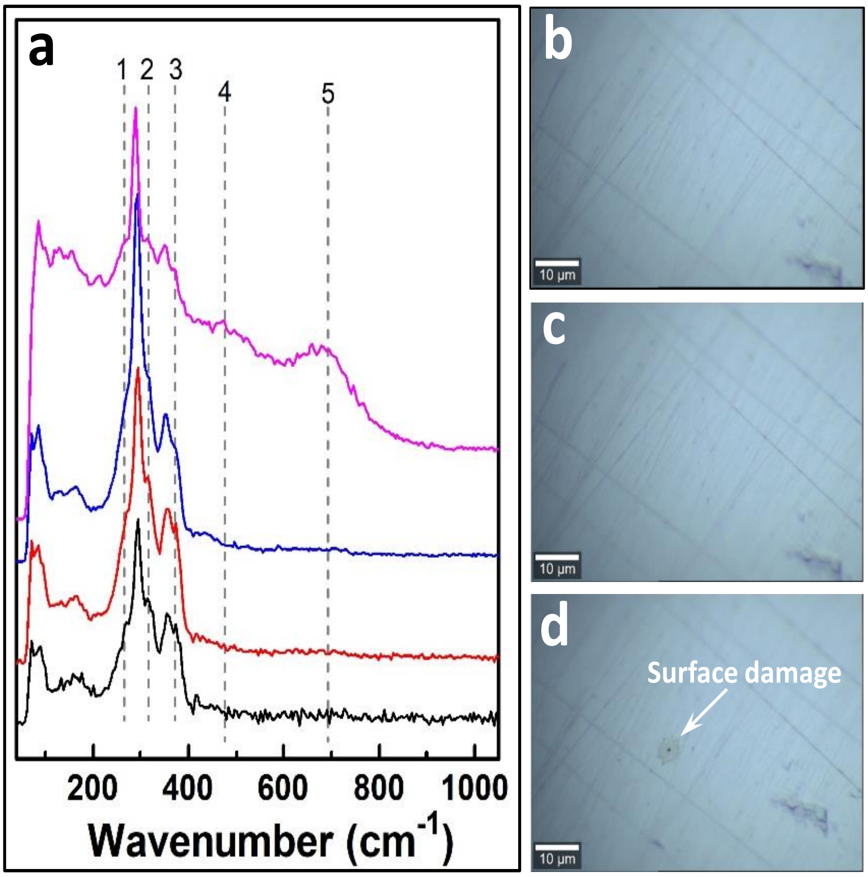

Figure S4. Raman spectra of fresh chalcopyrite collected using different laser powers (**a**) and optical microscope images before (**b**) and after Raman analysis at the minimum (**c**) and maximum laser powers (**d**).

S5. Overall Spectra Corresponding to Raman Mapping Data

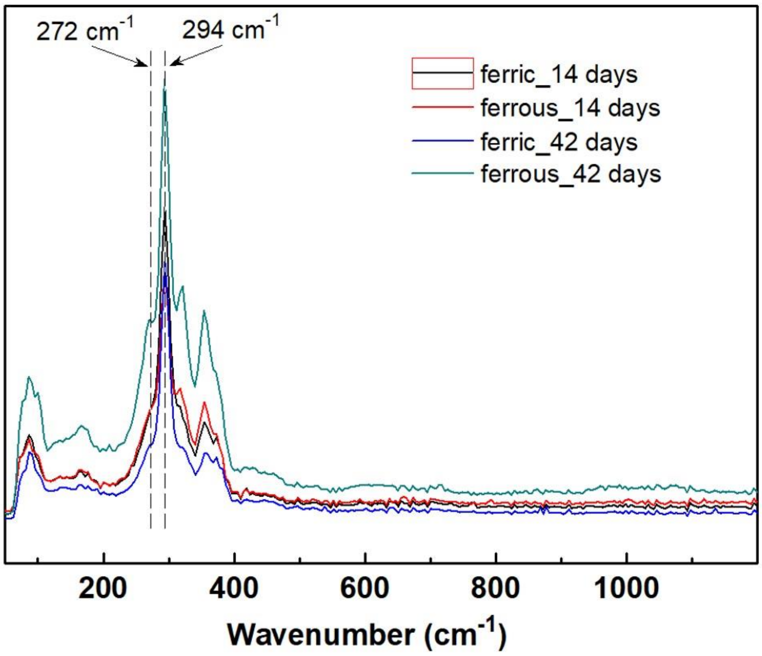

Figure S5. Raman spectra averaged over the entire Raman mapping areas as shown in Figures 3 and 4.