EUROPEAN SYNCHROTRON RADIATION FACILITY

INSTALLATION EUROPEENNE DE RAYONNEMENT SYNCHROTRON

Experiment Report Form

	Experiment title: Revealing modifications of asbestos after prolonged stay in the lungs	**Experiment number**: LS3009
Beamline:	**Date of experiment**: from: 18/02/2022 to: 21/02/2022 from: 18/04/2022 to: 19/04/2022	**Date of report**: 09/09/2022
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Report:

The aim of the experiment was to investigate the possible changes in the crystal structure of mineral fibers and the nature of the iron-coating developing on the fibers itself after prolonged stay in the lungs.

To this aim, considered the size of the fibers (only 0.2 – 0.3 nm in diameters) and the correspondent small volume of sample probed, a nano-sized (150 nm) and high brilliant beam was essential for successful measurements. Single asbestos fibers embedded in the original lung tissue were fixed on Kapton sample holders. Most of the fibers were coated with an iron layer, therefore, x-ray fluorescence (XRF) mapping was exploited to locate the fibers (see Figure 1), and then perform the actual X-ray diffraction measurements (XRD). These latter, were performed at ~43keV, with a full rotation of the sample.

The XRD measurements performed on the uncoated areas of the fibers, revealed the pattern of crocidolite asbestos. Single crystal structural refinement is ongoing, but no alteration to the crystal structure appears evident. On the other hand, XRD measurements on the iron-layer revealed that the main phase is goethite (Figure 2). This result is somehow unexpected, as it was believed that the main iron phase would have been ferrihydrite, because the latter constitutes the mineral core of ferritin, an iron storage protein which is believed to be deposited on the fibers by the alveolar macrophages.

The extra beamtime was granted to measure important references, such as mineral fibers with a ferritin deposition performed in our laboratory. Simulations of the phase diagram of aqueous iron phases in the lung conditions are undergoing to support this new result.

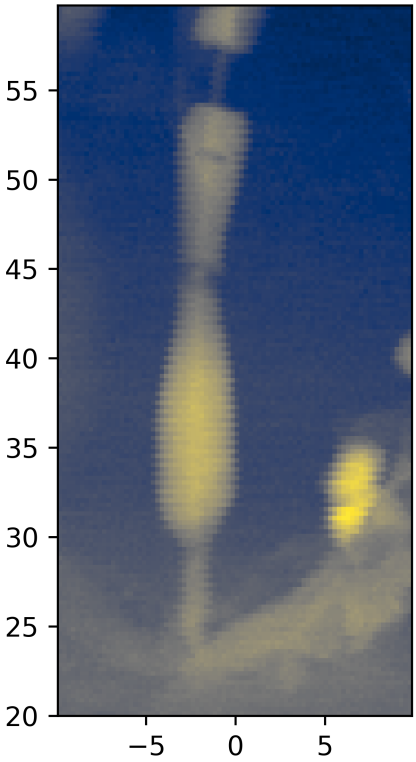

Figure 1. XRF map of a mineral fiber embedded in the lung tissue. The axis scales are in microns. Most of the fiber is coated by an iron-oxide layer

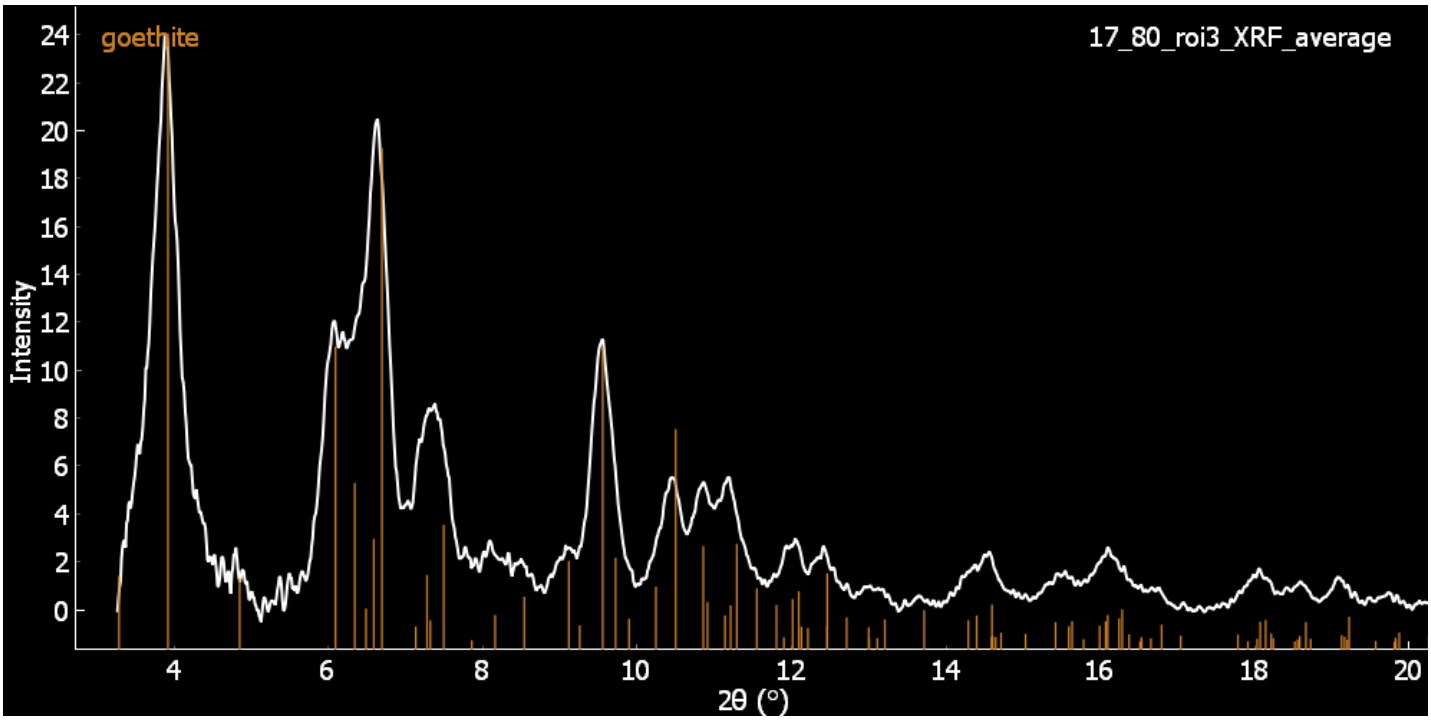

Figure 2. XRD pattern of an area of the iron-coating of a mineral fiber embedded in the lung tissue. The pattern matches well with the goethite reference pattern.