Laboratory Studies of X-Ray Amorphous Phases: Constraining the Amorphous Components in Martian Soils and Rocks

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Amorphous materials have been shown to constitute a significant fraction of Martian soils and rocks, according to previous lander-based X-Ray Diffraction and orbital Infrared (IR) measurements. However, the exact nature and chemistry of the phases that make up this component are not yet well understood. The Mars 2020 rover currently carries Raman and Visible/Near-Infrared (VNIR) reflectance spectrometers, which will also be on board the upcoming ExoMars rover. These spectrometers can offer new methods to characterize Martian surface materials in situ. Raman spectroscopy specifically has the potential to differentiate between amorphous phases. However, many of the Raman spectral databases are incomplete regarding many of the candidate amorphous phases. In this study, candidate X-Ray amorphous phases for the Martian soils imogolite and imogolite with chemisorbed sulfate and phosphate were synthesized and spectrally characterized using Raman spectroscopy to document the Raman peak locations for these materials. It was found that imogolite with adsorbed sulfate could be a potential host compound for sulfur and has distinguishable spectral features in the Raman data. The potential detection of adsorbed species is a unique characteristic of Raman spectroscopy. However, further research is needed to understand the conditions, abundances, and matrix compositions under which adsorbed species can be detected.

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