**Title:** Constraining the surface composition of asteroid (16) Psyche and supporting future observations from the NASA Psyche mission's Multispectral Imager using reflectance spectroscopy of metal-rich meteorites

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The Psyche Discovery-class mission, set to launch in 2022, will explore the structure and composition of asteroid (16) Psyche to test hypotheses about its formation and evolution. Variations in radar reflectivity, estimated density, thermal inertia, and visible to near-infrared reflectance spectra of asteroid (16) Psyche indicate that silicate minerals are likely intimately mixed with metal and may be heterogeneously distributed on the surface in low abundances. The Psyche spacecraft’s Multispectral Imager is designed to map the surface at high spatial resolution and to provide compositional information about the surface using 7 narrowband filters at visible to near-infrared (~0.4 to 1.0 µm) wavelengths. We report reflectance spectra of 31 meteorites with a range of bulk metal contents (irons, mesosiderites, pallasites, ordinary, enstatite, and carbonaceous chondrites, aubrites, a diogenite, and a lodranite) in a variety of physical forms and convolve them to Imager filter bandpasses. The meteorite spectra were measured using an ASD FieldSpec 4 under ambient lab conditions relative to a Spectralon calibration target with a phase angle of 30°. Ratios between convolved values for the filters show the Imager can discriminate different compositions to support mission science goals of mapping the degree of mixing of metal and silicates and detecting the presence of reduced minerals like oldhamite (CaS) and troilite (FeS). We determine spectral parameters (reflectance at 550 nm, slope, absorption band minima, center, and depth) to determine which meteorites are the best spectral matches for published spectral data of (16) Psyche. Finally, we discuss the cosmochemical relevance of these samples to the current formation hypotheses for (16) Psyche.

**Plain language summary:** Asteroids are the leftover building blocks from the formation of the planets. One type of asteroid appears to be made mostly of metal and may be the core of a planet, much like the Earth’s core. The Psyche mission will explore the largest of these types of asteroids using multiple scientific instruments. One of those instruments is a camera that can ‘see’ light that humans cannot. This light can tell us more about what materials may be on the surface of the asteroid (16) Psyche. To understand data that the camera may return to Earth, we studied a set of meteorites that are also very rich in metal using the same wavelengths of light that camera can see. We show that the camera is capable of uniquely identifying different meteorite types. This will inform our understanding of what (16) Psyche is made of.