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Interpretation of Ordinary Chondrites SNOM images: comparison with electromagnetic models

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To clarify the role of iron phase transformation induced in asteroid surfaces, we studied samples of Ordinary Chondrites of different types (different metallic content and shock degree) in laboratory, by means of the nanoimaging analytical technique SNOM (Scanning Near Field Optical Microscopy). In SNOM technique, a light beam is passed through an optical fiber, that ends in a tip. Tip width is smaller than light wavelength: in this way light passing through the aperture is confined by the dimension of the tip and hence a high spatial resolution (hundreds of nanometers) is obtained. Samples, whose dimensions are of micron order, is placed near the tip, in such a way that radiation emerging to the tip is forced to interact with it before diffracting out. Applying this technique, it's possible to retrieve a reflectivity image and a topographic image of the sample, having in this way evidence of npFe presence.

Laboratory analysis is supported by theoretical modelling that is performed using a code that allows to obtain the electromagnetic fields distribution in 3D space, after interaction between radiation and sample, and hence a reflectivity image of the sample at a fixed wavelength.

In the simulation, we consider a monochromatic plane wave addressed to a tip, 10 microns long and recovered by a thin silver layer. Sample, 700 nm far from the tip, is a 4mm2 square.

In preliminary simulations, we chosen materials that are very common in Ordinary Chondrites such as the olivine (forsterite and fayalite) and pyroxenes. In the code every material is described by the following input parameters: isotropy, relative dielectric constant, magnetic permeability, electric, magnetic and thermal conductivity, opacity and density.

Wavelengths considered here are 980 nm, 1050 nm, 1300 nm and 1550 nm, which correspond to maximum or minimum of olivine and pyroxenes reflectivity: in this way it's easier to have npFe evidence. The comparison between real and simulated SNOM reflectivity images will help us to interpret the data and possibly to discern the presence and amount of npFe in the sample.