Low-temperature optical constant of amorphous silicate dust analogues

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Cosmic dust models are key ingredients in advancing our understanding of astronomical environments as diverse as interstellar clouds in galaxies, circumstellar envelops around evolved and young stars or protoplanetary disks. They consist of several dust populations having different compositions and size distributions. They may also consider different grain shapes although most models assume spherical grains. All include a component of silicate dust. The absorption and emission properties of these dust components are calculated from the optical constants of each dust material which have various experimental, phenomenological or theoretical origins depending on the models.

We aim to provide the community with new sets of optical constants for amorphous silicate dust analogues at low temperature. The analogues consist in four Mg-rich silicate samples of stoichiometry ranging from enstatite to olivine and of eight samples of Mg- and Fe-rich silicates with a pyroxene stoichiometry and various amounts of magnesium and iron content. The optical constants were calculated from transmission measurements using Kramers-Kroning relations assuming that the grains are small compared to the wavelength and that they have a prolate shape with axis ratios of 1.5 and 2 for the Mg and Fe-rich samples, respectively.

New optical constants of silicate dust analogues of various compositions are calculated in the spectral range from 5 to 800 - 1000 μm at temperatures 10, 30, 100, 200 and 300 K. We determined the uncertainties on the derived optical constants induced by the assumptions made to calculate them. To ease the use of these data in cosmic dust models we provide optical constants extrapolated outside the measured spectral range, into the UV/VIS/NIR and mm-cm wavelength ranges and formulae that can be used to interpolate the optical constants at any temperature in the range from 10 to 300 K. These twelve sets of optical constants of amorphous silicate dust analogues, their associated uncertainties and the extrapolated optical constants are publicly-available on the STOPCODA (SpecTroscopy and Optical Properties of Cosmic Dust Analogues) database (https://www.sshade.eu/db/stopcoda).