Methanol band strength changes due to density variations

M. Á. Satorre,[1] G. Molpeceres,[2] R. Luna,[1] J. Ortigoso,[2] M. Domingo,[1] R. Escribano,[2] C. Santonja,[1] and B. Maté[2]

[1]*Centro de Tecnologías Físicas, Universitat Politècnica de València, Spain*
[2]*Instituto de Estructura de la Materia, IEM-CSIC, Spain*

Infrared band strengths are affected by ice density. Up to now no density values were available for temperatures covering from amorphous to crystalline ices. This presentation will show new experiments where density was measured at different temperatures from 20 K to 130 K. Ices were grown by vapour background deposition in two high vacuum chambers in the same conditions. Densities were measured via a cryogenic quartz crystal microbalance (mass deposited per surface unit) and laser interferometry (thickness). Absorbance infrared spectra of methanol ices of different thickness were recorded to obtain optical constants using an iterative minimization procedure. Infrared band strengths were determined from infrared spectra and ice densities.

Solid methanol densities measured at eight temperatures vary between 0.64 g cm^3 at 20 K and 0.84 g cm^3 at 130 K. The visible refractive index at 633 nm grows from 1.26 to 1.35 in that temperature range. New infrared optical constants and band strengths are given from 650 to 5000 cm^{-1} (15.4–2.0 μm) at the same eight temperatures. The study was made on ices directly grown at the indicated temperatures, and amorphous and crystalline phases have been recognized. Our optical constants differ from those previously reported in the literature for an ice grown at 10 K and subsequently warmed. The disagreement is due to different ice morphologies. The new infrared band strengths agree with previous literature data when the correct densities are considered.