SSHADE Users Newsletter – March 2024 –

Focus on ices

Dear SSHADE users,

For this final month of winter, we present a spotlight on ices. The generic term of 'ices' covers all the molecular solids more volatile than water ice and with a melting point below 0°C. Among the wide range of samples contained in SSHADE, there are more than **30 different species of ices in about 50 different phases**.

You can find:

- Inorganic ices, such as
    - N_2, O_2, O_3, CO, CO_2, H_2O, NH_3, …
    - Sulfur compounds: H_2S, SO, SO_2, S_2O…
- Organic ices, such as
    - hydrocarbons: CH_4, C_2H_2, C_2H_4, C_2H_6, C_3H_8, C_4H_2, C_6H_6 …
    - nitriles: HCN, C_2N_2, C_4N_2, HC_3N, CH_3CN, CH_3CH_2CN, $(CH_3)_2CHCN$…
    - CH_3OH, H_2CO, CH3COOCH3,
- Compounds, such as clathrates of CO_2, CH_4

More than 2500 spectra recorded on ices are already present in SSHADE, as well as **35 absorption and Raman bandlists**.

Most spectra and bandlists are dedicated to the spectral properties of **pure synthetic ices** in various amorphous and crystalline phases, but there is also a number of spectra concerning **natural ices** (snow, firn ice and glacier ice) as well as simple binary to complex **mixtures of different types** (molecular or granular mixtures, layered samples…). They frequently cover a range of low temperatures, and some belong to experiments studying some physical or chemical process such as differential sublimation, energetic irradiation, …

The ice spectra encompass a large spectral range and various types of measurements.

- **Transmission spectra**, in transmittance, absorbance or absorption coefficient unit, can be found **from VUV to far-infrared**. You can for instance find the spectra of H2S in 4 different phases:


MIR absorption coefficient spectra of H2S (nu_1,nu_3 bands) in 3 different phases (amorphous, III, II) and diluted in SO2 ice
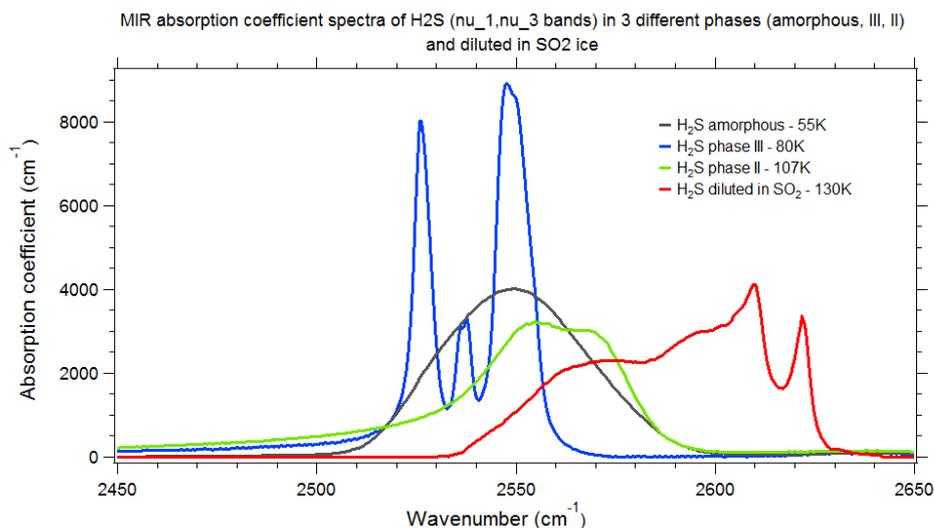
Or VUV data concerning amorphous Acetonitrile (CH₃CN), a component present in the atmosphere or at the surface of icy bodies, such as Titan, and possibly Pluto.

VUV absorbance spectra between 10 and 120 K of amorphous CH3CN deposited at 10 K
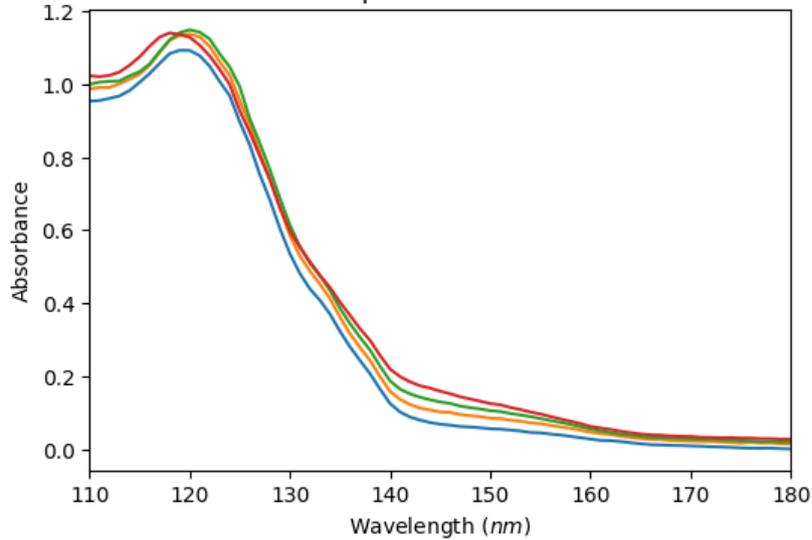
- SSHADE also contains higher level products, such as **optical constants** data **throughout the infrared range** for ices, such as water ice.


Near and Mid-IR optical constants of crystalline H2O ice Ih at 140-145K
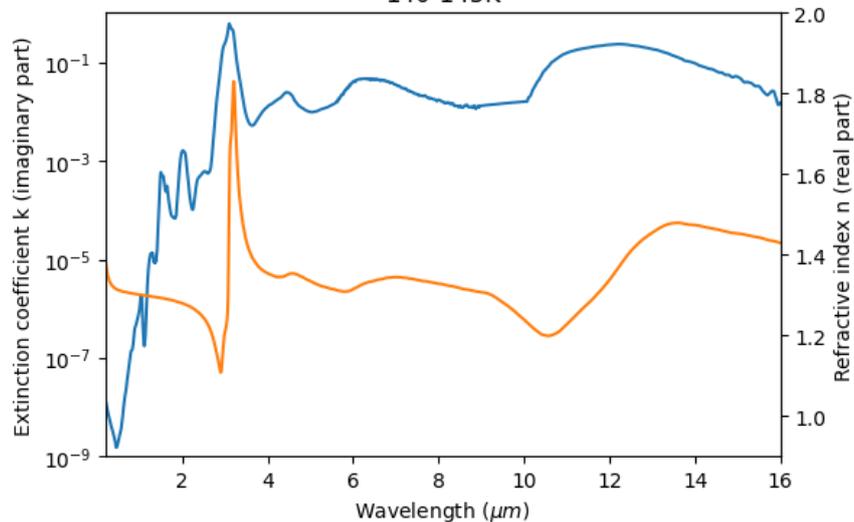
- SSHADE also contains **reflectance spectra and BRDF in the Vis and NIR ranges** for some of the less volatile ices, such as H_2O and CO_2, pure or mixed with minerals or organic matter. You can find for instance, reflectance spectra of icy analogues of the Martian surface made of CO_2 ice associated in different ways with H_2O ice and a regolith simulant.

- These last 2 years the spectral properties of **17 ices** have been carefully reviewed to create an unique product from SSHADE: their **absorption and Raman bandlists** from the far to near-infrared and sometimes the VUV:
  - N_2, CO, CO_2, CH_3OH, H_2O, NH_3, H_2S, SO, SO_2, S_2O…
  - CH_4, C_2H_2, HCN, C_2N_2, C_4N_2, HC_3N, CH_3CN

Absorption band list of crystalline NH3 in natural solid NH3 (phase I)
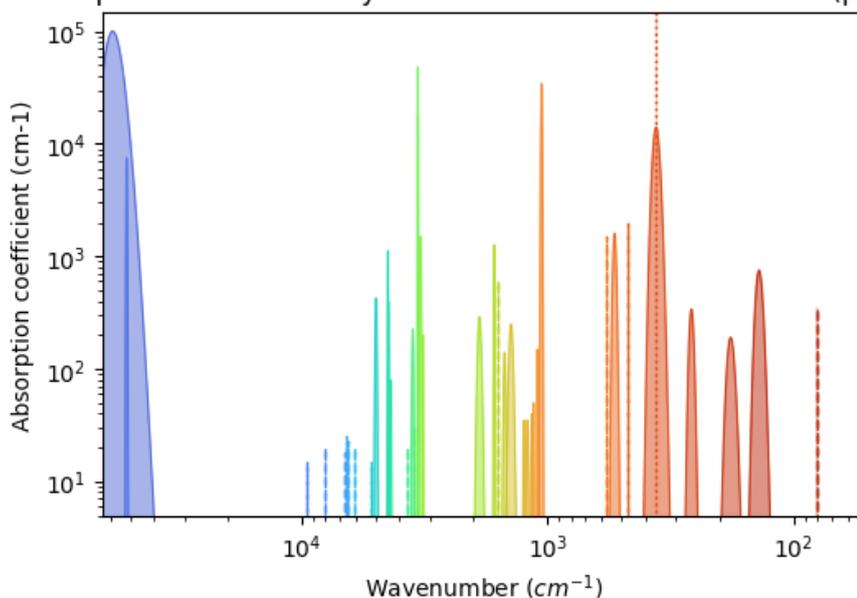
For each of these ices, SSHADE also provides detailed information on the solid properties, such as its chemical formula, the list of chemical bonds that compose it, its crystallographic, physical (molar mass, density…), optical (refraction index…), and thermodynamical properties (solid-solid phase transitions…).

Stay tuned for future data.

Have fun with SSHADE data!

The SSHADE Team

All previous user newsletters are stored in the dedicated **'News' page** of the SSHADE Wiki