Synthesis and characterization of carbonic acid (H_2CO_3) has been an elusive task until the early nineties. In fact, the textbook opinion was that it can not be isolated at all because of its rapid decomposition to carbon dioxide and water. In 1993 our group was for the first time able to isolate H_2CO_3 in its solid form using a cryo-technique and characterize it by means of FT-IR spectroscopy [Hage et al., J. Am. Chem. Soc., 115 (1993) 8427]. Meanwhile, comparison of laboratory spectra with spectra of stellar bodies has indicated the possibility of the prevalence of H_2CO_3 on the Martian surface, on Galilean satellites of Jupiter, comets like Halley and Edgeworth-Kuiper-Belt bodies.

On adapting the cryo-technique slightly by changing from aqueous to methanolic solution we were able to characterize a second crystalline polymorph of H_2CO_3. A major aim of the proposal at hand is to investigate whether other polymorphs can be generated by changing the solvent or using mixtures of solvents. The two known polymorphs as well as any polymorphs to be discovered will be characterized for the first time not only in situ by FT-IR spectroscopy, but also ex situ by Raman spectroscopy, differential scanning calorimetry and powder X-ray diffraction. The latter method opens the possibility of a crystal structure determination, which will be assisted by theoretical crystal structure predictions in the group of Prof. Sarah L. Price (UCL).

Besides its astrophysical relevance in the solid state there is also speculation that gaseous carbonic acid forms in the atmosphere of Venus and also in Earth's atmosphere. For a verification/falsification of this claim spectra of gaseous carbonic acid are required. Our succesful sublimation and recondensation experiment from 1998 for a carbonic acid polymorph [Hage et al., Science, 279 (1998) 1332] opens the possibility of measuring such spectra in the laboratory. While it is not possible to detect carbonic acid directly in the gas-phase, the matrix isolation technique allows to record spectra of immobilized gas-phase species at low temperatures. The aim is, therefore, to record spectra of carbonic acid in an Argon matrix at low temperatures.