Spontelectric effect in solid nitrous oxide (N_2O): a RAIRS study of dipole alignment

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It has recently been discovered at the ASTRID laboratory (ISA) at Aarhus University that solid cryofilms of simple species such as nitrous oxide (N_2O), propane or toluene spontaneously polarise and give rise to significant surface potentials of typically several volts, corresponding to electric fields in excess of 10^8 $V.m^{-1}$. This so-called spontelectric effect arises from both local and long-range interactions due to the permanent dipoles of the constituent molecules. It has been suggested that the spontelectric fields form due to the alignment of the dipoles in the deposited films [1-6]**.**

Although the spontelectric effect cannot be directly observed with infrared spectroscopy, the degree of dipole alignment in the film can be estimated with this tool. To this aim, we performed reflection-absorption infrared spectroscopy (RAIRS) experiments under ultrahigh vacuum on N_2O films. The influence of deposition temperature on the structure of solid N_2O is clearly seen, and is discussed in terms of dipole alignment of N_2O molecules in the film.

A preliminary study at Aarhus has shown that the spontelectric character is retained when N_2O is isolated in a xenon (Xe) matrix. One could then question whether N_2O remains isolated in the Xe matrix upon deposition, or if it segregates to form a pure N_2O phase. Our RAIRS results show that segregation of N_2O does not occur in Xe, suggesting that the dipole alignment believed to give rise to the observed spontelectric field is due to an extended network of dipole-dipole interactions within the film.

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