VIBRATIONAL SPECTROSCOPY AND REACTIVITY OF ULTRA-SMALL SILICA and SILICATE FRAGMENTS IN THE GAS-PHASE

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Silicates are ubiquitously found as small dust grains throughout the universe. These particles are frequently subject to high-energy processes and subsequent condensation in the interstellar medium (ISM), where they are broken up into many ultra-small silicate fragments. Such fragments can be astrochemically relevant for the formation and dissociation of small molecules, such as H_2, H_2O, O_2, or CO_2. In our work, we use methods that are well established in the field of cluster chemistry and physics and are now transferred to addressing astrochemically relevant materials: infrared multiple-photon dissociation (IR-MPD) spectroscopy combined with ion trap and flow tubes reaction studies. With this approach we aim to gain insight into the geometric structure of ultra-small silica and silicate fragments as well as their reactive and catalytic properties. In particular, I will present first results on the infrared spectrum of the pyroxene monomer $MgSiO_3$, its surprisingly strong interaction with molecular oxygen, and potential initial steps of particle nucleation. Furthermore, I will address the interaction of ultra-small silica clusters with water leading to the hydroxylation of the clusters and a characteristic band in the IR-MPD spectrum, which was not detected for bulk silica.