Meteoric Smoke Particles in the Mesopause – the only long-lived sub-nanometer particles in the atmosphere.

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At the very low temperature and pressure of the mesopause in a height of ~85km, trace metal atoms originating from evaporated meteors co-nucleate with oxygen into very small (r<1nm) mineral particles called meteoric smoke particles (MSP). The main composition is $Mg_xFe_{2-x}(SiO_4)$. Due to the low pressure in the mesosphere and the low mixing ratio of the metals, these particles can be stable at this size over months.

During polar summer, water ice may nucleate on these particles to form polar stratospheric clouds. These most elusive clouds in the atmosphere have only been observed since 1885, but since then, their brightness and extension seem to be increasing. This has been brought into connection with climate change, but the evidence is not strong.

In this contribution, we will present laboratory experiments on the nucleation of water ice on synthetic MSP stored in a linear quadrupole trap under the conditions of the polar mesosphere. We study the nucleation of ice under these extreme conditions and find that very high supersaturation is necessary for its formation, which initially nucleates as amorphous ice and crystallizes into quasi-cubic ice only at higher temperatures.