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Ice multiplication in levitated microdroplets

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The rapid glacification of tropospheric clouds is a remaining mystery in cloud physics. Commonly, this process is attributed to secondary ice processes or 'ice multiplication'. One of the proposed mechanisms, the fragmentation of freezing water droplets, was investigated using supercooled droplets observed in an electrodynamical levitator. After freezing initiation by collision with a small ice particle, supercooled droplets freeze in an two stage process. During the first rapid phase, the droplet is heated by the latent heat of freezing to the melting point within several hundred microseconds. After that, the ice growth rate is limited by the diffusive heat removal from the droplet and the remaining water freezes from outside in within several hundred milliseconds.
During that phase, pressure inside the droplet can build up due to the density change associated with the phase change and due to dissolved gases that are excluded from the crystalline ice. Eventually, the outer ice shell may rupture under this pressure and the droplet may fragment or small ice particles may be released. We report the dependence of the probability of such disintegration processes as a function of temperature and the content of solid particles within the droplet as well as their dynamics.