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Cavitation in confined water: ultra-fast bubble dynamics OLIVIER VINCENT, PHILIPPE MARMOTTANT, CNRS and University of Grenoble, Lab. Interdiscplinaire de Physique, France — In the hydraulic vessels of trees, water can be found at negative pressure. This metastable state, corresponding to mechanical tension, is achieved by evaporation through a porous medium. It can be relaxed by cavitation, i.e. the sudden nucleation of vapor bubbles. Harmful for the tree due to the subsequent emboli of sap vessels, cavitation is on the contrary used by ferns to eject spores very swiftly. We will focus here on the dynamics of the cavitation bubble, which is of primary importance to explain the previously cited natural phenomena. We use the recently developed method of artificial tress, using transparent hydrogels as the porous medium. Our experiments, on water confined in micrometric hydrogel cavities, show an extremely fast dynamics: bubbles are nucleated at the microsecond timescale. For cavities larger than 100 microns, the bubble "rings" with damped oscillations at MHz frequencies, whereas for smaller cavities the oscillations become overdamped. This rich dynamics can be accounted for by a model we developed, leading to a modified Rayleigh-Plesset equation. Interestingly, this model predicts the impossibility to nucleate bubbles above a critical confinement that depends on liquid negative pressure and corresponds to approximately 100 nm for 20 MPa tensions.

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