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Nucleation and ultrafast vaporization dynamics of laser-activated polymeric microcapsules[1] GUILAUME LAJOINIE, ERIK GELDERBLOM, Physics of Fluids group, University of Twente, CECIEL CHLON, MARCEL BOEHMER, Philips Research Laboratories Europe, WIENDELT STEENBERGEN, Biomedical Photonic Imaging, University of Twente, NICO DE JONG, Biomedical Engineering, Erasmus MC Rotterdam, SRIRANG MANOHAR, Biomedical Photonic Imaging, University of Twente, MICHEL VERSLUIS, Physics of Fluids group, University of Twente — Precision control of vaporization, both in space and time, has many potential applications; however, the physical mechanisms underlying controlled boiling are not well understood. The reason is the combined microscopic length scales and ultra-short timescales associated with the initiation and subsequent dynamical behavior of the vapor bubbles formed. Here we study the nanoseconds vapor bubble dynamics of laser-heated single oil-filled microcapsules using coupled optical and acoustic detection. Pulsed laser excitation leads to vapor formation and collapse, and a simple physical model captures the observed radial dynamics and resulting acoustic pressures. Continuous wave laser excitation leads to a sequence of vaporization and condensation cycles, the result of absorbing microcapsule fragments moving in and out of the laser beam. A model incorporating thermal diffusion from the capsule shell into the oil core and surrounding water reveals the mechanisms behind the onset of vaporization. Excellent agreement is observed between the modeled dynamics and experiment.

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