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Cavitations induced by plasmas, plasmas induced by cavitations, and plasmas produced in cavitations

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Cavitation bubbles are not static bubbles but have dynamics of expansion, shrinkage, and collapse. Since the collapse of a cavitation bubble is roughly an adiabatic process, the inside of the bubble at the collapse has a high temperature and a high pressure, resulting in the production of a plasma. This talk will be focused on cavitation-related plasma phenomena and the role of the cavitation bubble in the synthesis of nanoparticles. A method for inducing a cavitation bubble is laser ablation in liquid. After the disappearance of laser-produced plasma with optical emission, we have observed the formation of a cavitation bubble. We have found that the inside of the cavitation bubble is the reaction field for the synthesis of nanoparticles. The atomic and molecular species ejected from the ablation target toward the liquid are transported into the cavitation bubble, and they condense into nanoparticles inside it. It is important to note that nanoparticles are stored inside the cavitation bubble until its collapse. We have shown that the size and the structure of nanoparticles are controlled by controlling the dynamics of the cavitation bubbles. Another method for inducing cavitation bubbles is to use ultrasonic power. We have found a simple method for the efficient production of standing cavitation bubbles. The method is just inserting a punching metal plate into water irradiated by ultrasonic wave. The depth of water and the position of the punching plate should be tuned precisely. We have proposed the mechanism of the efficient production of cavitation bubbles by this method. Currently, we try to have electric discharges in cavitation bubbles with the intention of realizing nonequilibrium sonochemistry. In particular, the electric discharge in a laser-induced cavitation bubble shows interesting distortion of the bubble shape, which suggests the electrostatic characteristics of the cavitation bubble.