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Generation Mechanism of Opto-Acoustic Wave from in vivo Imaging Agent

Authors : Hiroyuki Aoki

Abstract : The optoacoustic effect is the energy conversion phenomenon from light to sound. In recent years, this optoacoustic effect has been utilized for an imaging agent to visualize a tumor site in a living body. The optoacoustic imaging agent absorbs the light and emits the sound signal. The sound wave can propagate in a living organism with a small energy loss; therefore, the optoacoustic imaging method enables the molecular imaging of the deep inside of the body. In order to improve the imaging quality of the optoacoustic method, the more signal intensity is desired; however, it has been difficult to enhance the signal intensity of the optoacoustic imaging agent because the fundamental mechanism of the signal generation is unclear. This study deals with the mechanism to generate the sound wave signal from the optoacoustic imaging agent following the light absorption by experimental and theoretical approaches. The optoacoustic signal efficiency for the nano-particles consisting of metal and polymer were compared, and it was found that the polymer particle was better. The heat generation and transfer process for optoacoustic agents of metal and polymer were theoretically examined. It was found that heat generated in the metal particle rapidly transferred to the water medium, whereas the heat in the polymer particle was confined in itself. The confined heat in the small particle induces the massive volume expansion, resulting in the large optoacoustic signal for the polymeric particle agent. Thus, we showed that heat confinement is a crucial factor in designing the highly efficient optoacoustic imaging agent.

Keywords : nano-particle, opto-acoustic effect, in vivo imaging, molecular imaging
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