Dual-mode transducer for high resolution imaging and thermal therapy

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The medical image-guided high intensity focused ultrasound (HIFU) is being clinically accepted to achieve more accurate positioning of the probe and therapeutic monitoring. The main advantage of this technique is that it ensures therapeutic ultrasound correctly aligned with the planned volume before the treatment. High resolution ultrasound imaging is required for better diagnosis analyses which aimed at the early evaluation of diseases. However, due to the limitation of previous transducer designs which shares the single element for both imaging and therapy, it unavoidably suffers from providing the high frequency ultrasound imaging. In this study, we have developed a novel switchable dual-mode ultrasonic transducer that performs high resolution ultrasound imaging and HIFU ablation. One transducer included a 20 MHz single element transducer for high resolution imaging, and the other transducer provided a 5 MHz single element transducer for high efficiency of thermal effect efficiency. The temperature change generated by HIFU was calibrated using the optic fiber measurement. The transducer was experimentally validated in vivo using the mouse liver, presenting the coagulation necrosis after treatment. B-mode and C-mode images (before and after treatment) displayed a hyperechoic region which represents the HIFU treated area. This feasibility study showed switchable dual-mode transducer can result in significant improvement in spatial resolution as well as in thermal efficiency.