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**Miniature, high efficiency transducers for ultrasonic flow meter applications**

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This paper is concerned with the development of novel, miniature, high efficiency transducers for use in ultrasonic flow meters. Theoretical and experimental work done in our laboratory has shown that a flat, planar transducer that has minimal protrusion into the flow pipe can be realized based on conversion of plate acoustic waves (PAWs) to bulk acoustic waves (BAWs) and vice versa. The transducer is essentially a thin plate of a suitable piezoelectric material on which interdigital transducers (IDTs) are fabricated to generate and detect plate acoustic waves. With proper design very efficient conversion of energy from plate waves in the piezoelectric material to bulk waves in the fluid (and vice versa) can be achieved. For example, using lithium niobate as the piezoelectric material and water as the fluid, total conversion loss (PAW to BAW and back from BAW to PAW) of less than 2.5 dB has been obtained. An important advantage of plate waves is that since wave energy is present on both plate surfaces, the IDT can be on the surface opposite from that which is in contact with the fluid. Details of the theoretical analysis used, experimental results obtained, and potential applications will be presented.