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Integrated Plate Acoustic Wave Sensors for In-situ NDT Applications

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Abstract

Many military and commercial airplanes have exceeded or reached at their designed life time, and it is crucial to extend the usage life span of these fleets. In addition, new airplanes are highly demanded to be equipped with increased intelligence in flight control and to have light weight for fuel consumption reduction. Therefore there is an urgent need for miniature and light weight integrated in-situ sensors and systems for local and global damage detection and assessment in aerospace industries. The ultimate goal is to use these structurally integrated sensors, to inspect in-flight aircraft critical components, thus increasing platform availability and reducing associated maintenance costs.

In this investigation miniature and light-weight integrated plate acoustic wave (PAW) transducers have been developed. As one approach, thick films (>50μm) piezoelectric ultrasonic films were directly deposited onto the end edges of aluminum and stainless steel plates using a sol-gel spray technique. They were used to excite and receive symmetrical, anti-symmetric and shear horizontal types of PAWs in pulse/echo mode. The propagation length can reach more than one meter in frequencies of several MHz. In 2 mm thick plates line defects of 1 mm width and 1 mm depth were clearly detected at room temperature and 150°C.

Another approach was to use flexible thick film piezoelectric transducers glued to the edges of the above mentioned plates and to generate and detect PAWs in pulse/echo mode. The piezoelectric films were coated onto 50μm thick polyimide films equipped with high temperature glues as flexible transducers. Results of measurements at room temperature and 150°C will be provided. Discussions of advantages and disadvantages of these two approaches will be discussed.