High temperature ultrasonic transducer for continuous monitoring in harsh environments

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Ultrasonic transducers are used in a wide variety of contexts including, but not limited to oil and gas applications and nuclear power plants. In these facilities, pressurized pipes, vessels or tanks can often operate at temperatures up to 600 °C. Monitoring the remnant thickness of safety critical infrastructure is key to ensure safety. Thickness gauging is typically performed at ambient temperature following a maintenance calendar. Indeed, conventional ultrasonic testing cannot be performed in service due to the temperature limitation of the probes. The literature demonstrated probe working continuously up to 350 °C. However, when the temperature keeps rising, they require an air- or water-cooling system to work or a delay line to move the probe away from the heat source. Fitting such probes under insulation becomes a complex endeavour. In this study, a novel high temperature ultrasonic transducer is presented with a new backing layer. Due to careful matching of the thermal properties of each layer, the transducer is able to handle high temperature and the associated thermal cycles with a small footprint. The transducer diameter is 25 mm and its height is 30 mm. In order to validate the performance of a 2.25 MHz probe, it was mounted on a 32 mm steel plate inside a furnace from 20°C to 750°C. The transducer maintained its performance for three months at 600°C and even reached 750 °C for 72 hours. The influence of temperature and time on the performances and associated phenomena, such as propagation velocities and wave attenuation for thickness detection, are discussed over three months.