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Turning up the Heat on NDE

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ABSTRACT

Ultrasonics and acoustic emission are techniques currently being considered by many manufacturers for monitoring materials processes. Before the potential of these techniques can be fully realized, the interaction between ultrasonic waves and materials must be understood and described quantitatively. Many processes take place under conditions other than ambient, and chief among these is high temperature. Exposure to high temperatures causes most materials, and especially composites, to soften. Their viscosity decreases until their behavior approximates that of a viscous fluid. Examples of high temperature industrial processes are resin transfer molding, molten metal infiltration, rheocasting of alloys of composite metals and laser drilling/shaping.

The interaction of waves with viscous fluids is an additional complication adding to an already complicated problem of operating a sensor at high temperature for extended periods of time. This report provides an insight into wave-material interactions, sensor techniques, and the approaches to process monitoring. The presentation is structured around this theme by reviewing a model of the interaction between the acoustic field and viscous materials. Next a survey of sensor technologies is presented for in-situ high temperature monitoring. Then a review is presented of several selected processes, for which monitoring approaches have been developed and valuable sensor data have been obtained. The conclusion summarizes the results and points to further needs and opportunities in modeling, sensor development and the evaluation of process sensor data.