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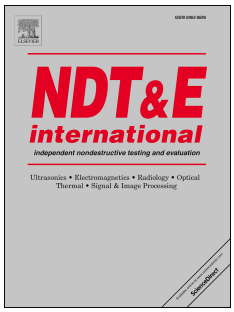

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Selective Modal Excitation for Optimization of Waveguide Based Bulk Ultrasonic Transducers

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ABSTRACT

The use of waveguides for ultrasonic transduction is advantageous in numerous applications such as measurement of flow, temperature and material properties under harsh environments. However, typically waveguide transducers do not use any mode control. This paper describes aspects of mode selection for waveguide based transduction of bulk longitudinal waves in a target metallic specimen. It is proposed that specific waveguide modes with suitable modal structure and matched acoustical impedance can significantly enhance the transduction of bulk ultrasonic waves in the specimen sample. Using circular cylindrical waveguides excited by magnetostriction, experimental results guided by finite element simulations and analysis are presented, demonstrating the feasibility of the approach. An example application in the form of a bulk longitudinal wave ultrasonic transducer is also provided describing the improvement in the signal quality using the proposed concept.

1. INTRODUCTION

This paper focuses on the optimization of a waveguide transducer system capable of generating ultrasonic waves in the bulk of a metallic material. McSkimin, 1959 [1] and Papadakis *et al.*, 1974 [2] were among the first to investigate waveguide based generation of bulk ultrasonic waves for Nondestructive Evaluation (NDE) of materials at both elevated and depressed temperatures. The principle for measurement of ultrasonic velocity and attenuation in the specimen under study using this approach [1, 2] is illustrated in Fig. 1. A waveguide is bonded to the specimen under examination in a temperature controlled environment. An ultrasonic transducer, typically using the principle of magnetostriction, is assembled on the other end of the waveguide which is placed under ambient conditions.