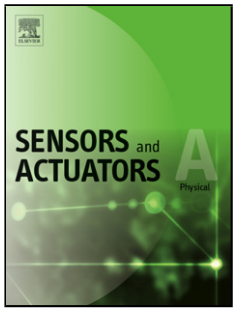

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Enhancement of EMAT's efficiency by using silicon steel laminations back-plate

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Highlights:

Magnetic back-plate enhance dynamic magnetic field and eddy current in sample.

Laminated silicon steel (SiFe) as back-plate restrain the eddy current in them.

SiFe laminations have better performance when provided bias magnetic field.

Abstract

Silicon steel laminations are introduced as the back-plate to an electromagnetic acoustic transducer (EMAT) to increase the efficiency of the EMAT by increasing the magnitude of the EMAT coil's dynamic magnetic field and the eddy current in the sample surface. A two-dimensional, non-linear finite element model is developed to quantify the effectiveness of the back-plate's different maximum permeability and saturation flux density, on increasing the eddy current density and the dynamic magnetic flux density in the specimen. A three-dimensional FE model is also developed, and confirms the expected result that the laminated structure of silicon steel (SiFe) markedly reduces the eddy current induced in the back-plate, when compared to a continuous slab of the steel. Experimental results show that silicon steel lamination can increase the efficiency of the EMAT in the cases both with and without a biasing magnetic field.

Key words

EMAT, Silicon steel lamination, back-plate, Lamb wave, non-linear finite element model

1, Introduction

Electromagnetic acoustic transducers (EMATs) are electromagnetically coupled ultrasonic transducers which are able to generate and detect ultrasonic waves on electrically conducting media. The EMAT's non-contact nature facilitates working at elevated temperature or on moving objects. The flexibility to easily change the shape of EMATs makes their application targets multifarious, from metal plates (strip), pipes, sticks to steel rails[1-3] . Furthermore, EMATs can generate various kinds of wave modes with different magnetic field and coil configurations, such