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学位（博士）論文要旨

(Doctoral thesis abstract)

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論 文 題 目 (Title)	音響誘起電磁応答法を利用した鉄鋼における 残留応力の非破壊評価 (Nondestructive Evaluation of Residual Stress in Steel using Acoustically Stimulated Electromagnetic Response)

論文要旨（2000 字程度）
(Abstract(400 words))
※欧文・和文どちらでもよい。但し、和文の場合は英訳を付すこと。
(in English or in Japanese)

Steel is a major component used in machines, automobiles, buildings, and infrastructure. Undesirable residual stress is usually introduced during the manufacturing of these industrial products. Residual stress is one factor involved in the degradation and damage of the products. It is important to understand the magnitude and distribution of residual stress to maintain the integrity of a product. Since magnetic hysteresis properties are sensitive to stress in ferromagnetic materials, magnetic hysteresis measurement is a potential nondestructive method for evaluating residual stress in steel. Conventional magnetic hysteresis measurements have been limited to acquiring bulk hysteresis properties over the entire object through electromagnetic induction. Recently, however, the spatial mapping of local hysteresis properties has been demonstrated by ultrasound focusing and scanning. This technique is based on the generation and detection of the acoustically stimulated electromagnetic (ASEM) response. The signal intensity of ASEM response is proportional to the local piezomagnetic coefficient d_{loc} in the acoustically excited local area of the object. The magnetic field dependence of the ASEM intensity (ASEM hysteresis curve) corresponds to the field dependence of $d_{\mathrm{loc}}(H)$

The purposes of this study are as follows.

(i) To clarify the stress dependence of the ASEM hysteresis curve in steel and to find appropriate indexes for quantitative stress evaluation.

(ii) To verify the validity of the quantitative evaluation of residual stress by comparing to semi-destructive hole-drilling method (HD method).

First, we investigate the stress dependence of local hysteresis curves through the ASEM response using a tensile testing machine and provide conversion coefficients to estimate tensile stress from the values of local hysteresis properties. The results indicate that the coercivity H_{c} is the most suitable parameter for quantitative evaluation in the elastic region. In addition, the remanent magnetization signal V_{r} may be suitable for identifying plastically deformed areas in steel. Next, we demonstrate the quantitative evaluation of residual stress through H_{c} using a welded steel specimen. We confirm that H_{c} can be used for evaluating tensile residual stress in the high-stress elastic region by comparing to the HD method. In addition, the spatial distribution of residual stress is well visualized

by imaging V_r. Finally, we propose a guideline for the nondestructive evaluation (NDE) of tensile residual stress in steel by using the ASEM method.

The results of this study indicate that measuring magnetic hysteresis properties via ultrasonic excitation become a new method for the nondestructive evaluation of residual stress.

（英訳）※和文要旨の場合(400 words)