ElectrA

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INTRODUCTION

- Eddy current is a non-destructive testing electromagnetic based technique that is generated induction process as predicted by Faraday's Law.
- The eddy current will generates the secondary magnetic field that will be in the opposition of primary magnetic field. The magnetic flux is defined by a surface integral as calculated in Equation 1.

$$\Phi_B = \iint_{\sum(t)} \boldsymbol{B}(r,t).d\boldsymbol{A}, \qquad (1)$$

where *d***A** is an element of surface area of the moving surface Σ(*t*), **B** is the magnetic flux density and **B**·*d***A** is a vector dot product.

ElectrA

i. Background

- ElectrA is an electromagnetic-based system for the inspection of industrial structures and components.
- The system is developed specifically for application of defect detection and characterization in electrically conductive samples.
- It utilizes rectangular waveform for the coil excitation which will generate time-varying magnetic field at its surrounding.
- ElectrA uses a square waveform to drive the excitations coil.
- A square pulse consist a series of frequency contents in which its excitation allow a deeper eddy current penetration and this provide information about the defects location either at the surface or subsurface of the sample.

ii. ElectrA System

- ✓ Combination from multiple equipment including function generator, power amplifier, power supply and ElectrA sensor as a detector as illustrated in Figure 1.
- ✓ For the signals processing, all the signals detected by the coil will be transferred, displayed and process using the computer completed with data acquisition card.

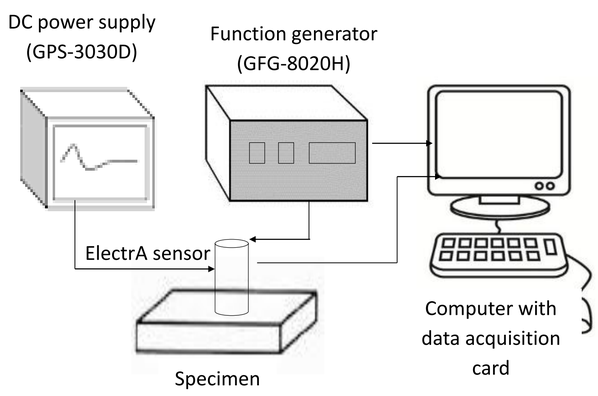

Fig. 1 ElectrA system

ElectrA SENSOR

- ➢ Fabricated with an excitation copper wire wounded around the ferrite core.
- ➢ In order to enhance the sensitivity of detection and empowering the magnetic field concentration a magnetic sensor (Hall SS490) was placed at the centre of the coil as illustrated in Figure 2.
- ➢ For a cylindrical coil located over a metal specimen the magnetic field in the air in the region of the specimen is given such as in Equation 2.

$$\boldsymbol{B_z} = \boldsymbol{B_Z^c} + \Delta\boldsymbol{B_Z} \qquad (2)$$

Where $\boldsymbol{B_Z^c}$the field is produced by the coil $\Delta\boldsymbol{B_Z}$ and is the field change caused by the specimen.

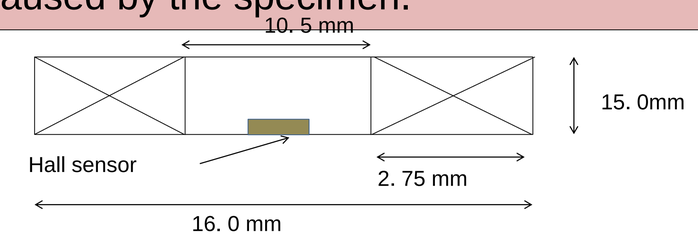

Figure 2. Schematic diagram of PEC coil

Table 1. Parameters of ElectrA sensor

Outside Diameter	Inside Diameter	Coil thickness	Height	Number of turns
16 mm	10. 5 mm	2. 75 mm	15 mm	300

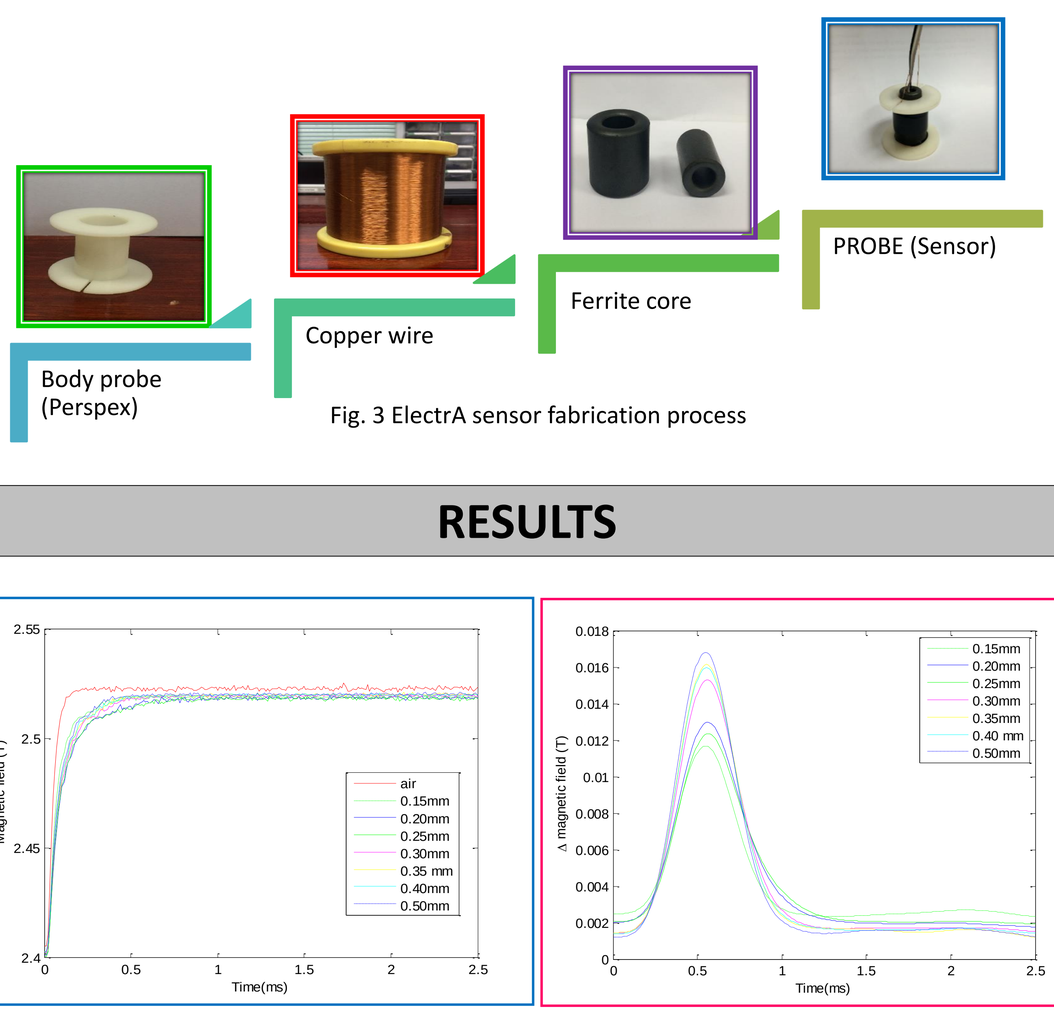

Fig. 3 ElectrA sensor fabrication process

RESULTS

Fig. 4 Time domain transient response of 8 different signals acquired on multiple defect depths

Fig. 5Time domain transient response of 8 different signals acquired on multiple defect depths

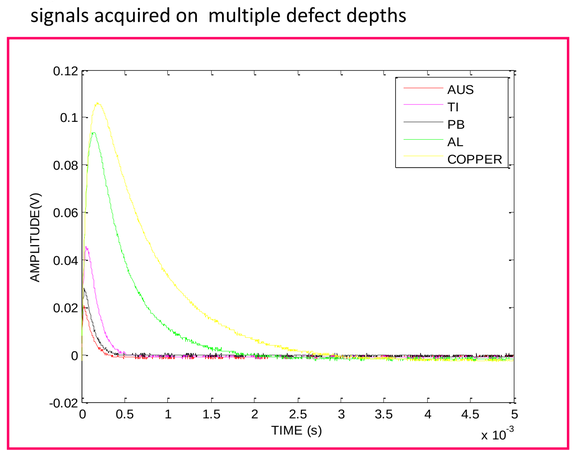

Fig. 6 The differential signal of conductivity testing on various specimens

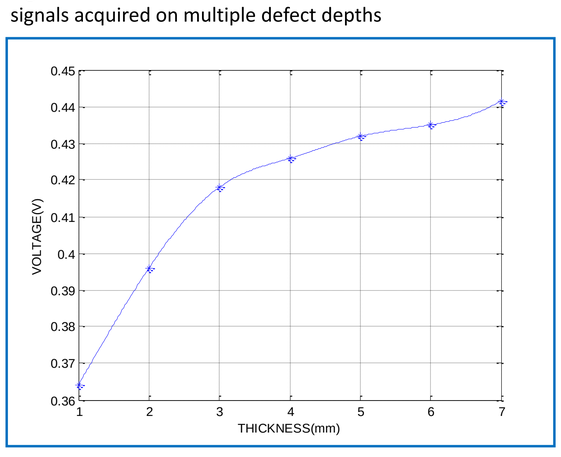

Fig. 7 Calibration graph for stainless steel 304 with thickness of 1mm to 7mm

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