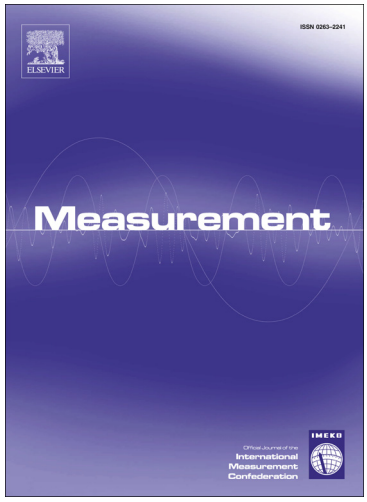

Flexible planar electromagnetic sensor array fabricated with printing electronic technology

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Flexible planar electromagnetic sensor array fabricated with printing electronic technology

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ABSTRACT
Although flexible planar electromagnetic sensor array has many advantages such as good conformability, strong adaptability and high efficiency, there is a conflict between their sensitivity and spatial resolution. The relationship between sensitivity and structural parameters of planar coil are analyzed in this paper, and a novel printing electronic technology (PET) is employed to fabricate the flexible planar electromagnetic sensor array. When the induction coil has the same spatial resolution, experiments indicate that the sensitivity of flexible planar sensor fabricated with PET is 10 times of that fabricated with traditional flexible printed circuit (FPC) technology, which can improve the detection ability to micro defects significantly. The flexible planar electromagnetic sensor array fabricated with this method can be applied to inspect components with irregular surface.
Keywords: printing electronic technology (PET)**,** Flexible sensor array, Planar electromagnetic sensor, Sensitivity, Spatial resolution

1. Introduction

Traditional coils have high response speed and high sensitivity, but they are usually large in volume and have rigid structure, which lead to low spatial resolution and weak flexibility. Because multiple units in an electromagnetic sensor array are hard to be made synchronously, their characteristics may vary greatly, thus have a limited capability to characterize micro cracks [1,2]. Flexible planar electromagnetic sensor array has many advantages such as good conformability, strong adaptability and high efficiency, which has important application in defect detection and on-line monitoring of complex components such as engine blades, rotor shafts, bolt holes, gas turbine components, and high-temperature components in power plants [3-8]. Several spatially periodic conformable eddy current sensor arrays were reported to monitor micro cracks, corrosions as well as residual and applied stress in metallic components [9-13]. However, due to the feature of planar structure and the limitation of fabrication technology, it is difficult to obtain both high sensitivity and high spatial resolution. In this paper, the relationship between sensitivity and structural parameters of planar coil are analyzed, and a novel printing electronic technology is employed to fabricate the flexible planar electromagnetic sensor array, which can improve the sensor sensitivity remarkably on the premise of ensuring spatial resolution.

This paper will address the performance analysis and printing electronic fabrication technology of planar electromagnetic sensor array. The rest of the paper is organized as follows. Firstly, the performance of planar electromagnetic sensor is analysed and the relationship between sensitivity and structural parameters of planar coil is obtained in Section 2. Next, the nanoimprint lithography to fabricate the flexible planar electromagnetic sensor array is illustrated in Section 3, which is followed by experimental results of sensor performance test and micro crack test in Section 4. Finally, our conclusions are outlined in Section 5.

2. Performance analysis of planar electromagnetic sensor