1P5-9

Cross-talk Evaluation of Phased Arrays Using Sol-gel Composites

ゾルゲル複合体を用いたアレイ素子のクロストーク評価

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1. Introduction

Ultrasound diagnostic apparatuses are widely used at medical field for reasons such as being non-invasive and real time. The scanning array probe of the apparatuses includes a number of small elements of piezoelectric material, which is used for ultrasound transmitting and receiving. In general, the piezoelectric material is fabricated by finely processing piezoelectric material. However, fine mechanical processing has disadvantage of high cost. Sol-gel composite piezoelectric material is the altanative method and it can avoid mechanical processing. The sol-gel composites have been studied mainly in the field of nondestructive testing in terms of flexibility [1] and performance under high temperature [2]. Kerfless linear arrays using sol-gel composites have also been studied. However, when kerfless linear arrays are fabricated, crosstalk between adjacent elements must be considered [3,4].

In this study, the crosstalks between elements of sol-gel composite piezoelectric sensor with various kerfs were measured.

2. Method

The sol-gel composite phased array was fabricated to investigate the crosstalk. In manufacturing process, the PZT/PZT solution was prepared by mixing PZT ceramics powder into PZT sol-gel solution. This mixed solution was coated on a stainless steel substrate using a spray machine, heat-treated at 650 C^{o}, and these process were repeated until the desired thickness. The thickness of the fabricated piezoelectric film is approximately 110 μm. After fabrication, polarization treatment was carried out using corona discharge. The resonant frequency of the arrays is approximately 7MHz. A mask was fixed on the piezoelectric film, and an upper electrode was formed by silver vapor deposition. In this study, linear arrays with various kerf were fabricated. Each array has eight elements. The height of the electrode was 2.2 mm, and the width was 1.2 mm. The kerfs were set as 0.3, 0.4, 0.5, and 0.6 mm, respectively. The image of linear arrays is shown in **Fig.1**.

To measure crosstalk, pulse-echo experiments were conducted. A sinusoidal wave with wave number of 5 and voltage of 10 Vp-p was applied by an arbitrary waveform generator to an element of the linear array, and the signal obtained at the neighboring element was measured. The applied sinusoidal wave was illustrated in **Fig.2**. The measurement was repeated 4 times for each element, and the average voltage was evaluated.

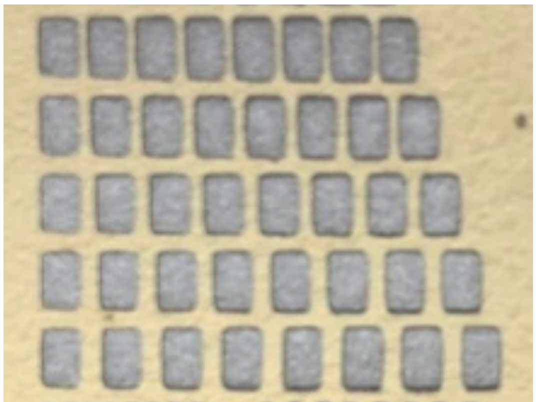

Fig.1 Picture of fabricated arrays

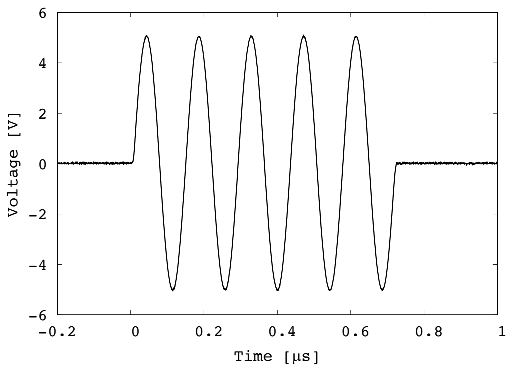

Fig. 2 Input signal.

3. Result

Figures 3-6 show the measured signals with the kerfs of 0.3 to 0.6 mm, respectively. Since the rising and falling parts of the signal were affected by the leakage current from the arbitrary waveform generator, the peak voltage in the middle part was measured. The result of each crosstalk between adjacent elements is shown in **Fig. 7**. It was confirmed that the value of crosstalk decreases as the kerf increases.

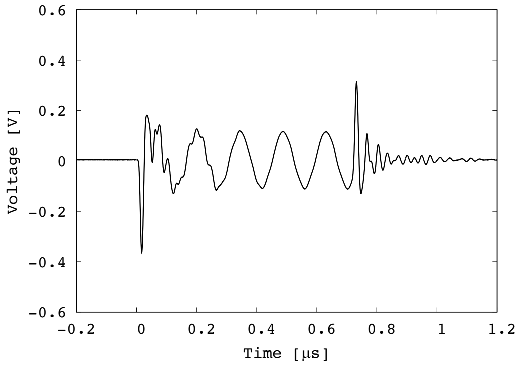

Fig. 3 Crosstalk signal between adjacent elements with the pitch of 0.6 mm.

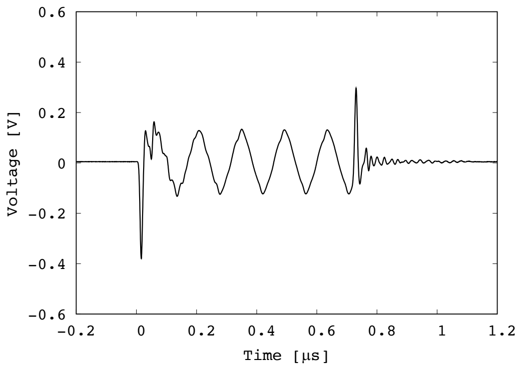

Fig. 4 Crosstalk signal between adjacent elements with the pitch of 0.5 mm.

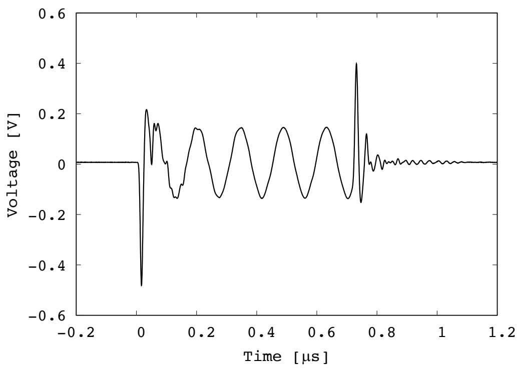

Fig. 5 Crosstalk signal between adjacent elements with the pitch of 0.4 mm.

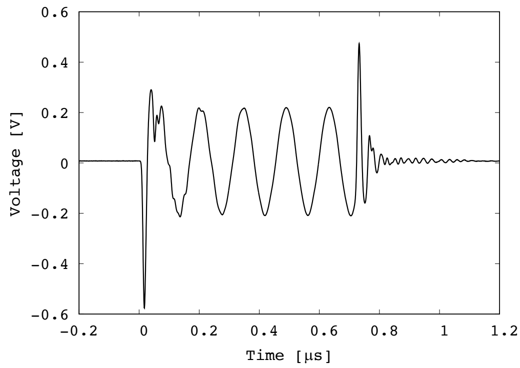

Fig. 6 Crosstalk signal between adjacent elements with the pitch of 0.3 mm.

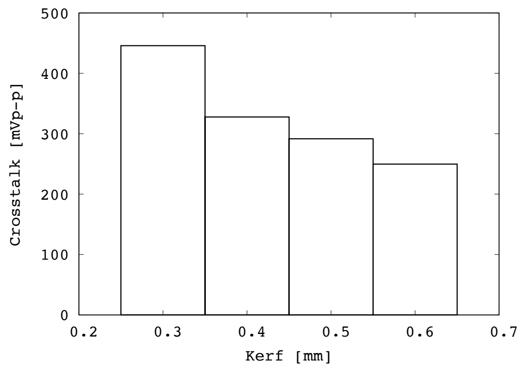

Fig. 7 Averages of crosstalk between adjacent elements with various pitches.

4. Conclusion

In this study, the crosstalks between adjacent elements with various kerfs were investigated. As a result, it is found that the crosstalk increased with closer kerf. In future work, the effect of the properties of the sol-gel composite material on the crosstalk will be investigated.

Acknowledgment

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