Improved Driving Characteristics for the Toner Transportation System

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Abstract

In this paper, we show an improvement of driving characteristics for the toner transportation system.

We have obtained the following major results:

(1) By vibrating with the sheet printed periodic array-conductors for toner transportation, the amplitude of four phase rectangular pulses can be greatly decreased.
(2) Toner particles adhered on the sheet of periodic array-conductors by the adhesive force is almost removed by vibration.

Introduction

We have already presented that the toner particles can be transported by means of traveling wave which is called the electric-curtain generated on the sheet of periodical-array-conductors driven by the four-phase rectangular pulses and the $\Sigma q/\Sigma m$ of toner particles can be easily measured by using the toner transportation system.[1,2,3,4]

In this system, it is necessary to decrease the adhesive forces which act to the toner particles on the sheet of periodical-array-conductors in order to the improvement of driving characteristics for the toner transportation.

In this paper, we tried to obtain a solution of this problem by the use of the vibration technique.[3]

Transportation System of Toner Particles

Figure 1 shows the schematic diagram of the experimental system for transporting charged toner particles.

This system consists of the four-phase rectangular pulse generator, the sheet of periodical-array-conductors for toner-transportation, the sense electrodes of charged toner particles and the CCD camera system for observing the movement of toner particles.

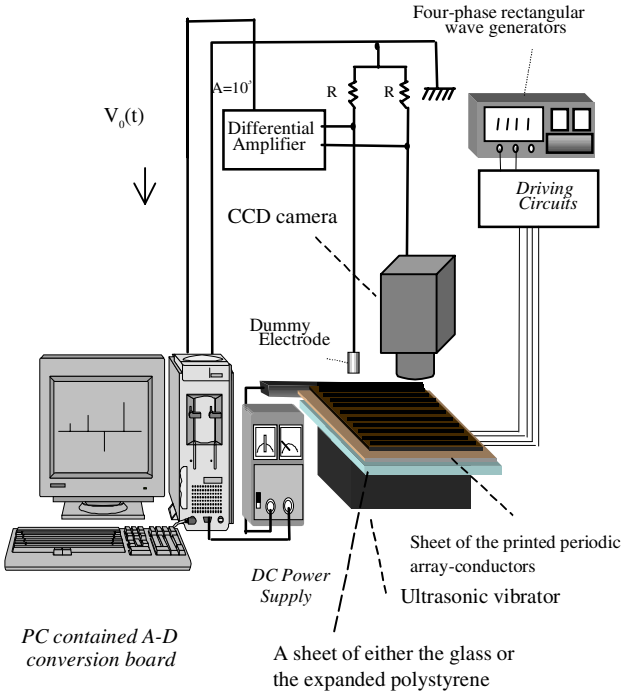

Figure 1. Schematic diagram of the experimental system

Figures 2 and 3 show the structure of the sheet of periodical-array-conductors for the transportation of toner particles.

The periodical-array-conductors are connected to the four-phase rectangular pulse generator.

Charged toner particles are put on the sheet of periodical-array-conductors on the left side in this figure and the sheet of these conductors driven by the four-phase rectangular pulses is swung to the vertical direction by the ultrasonic vibrator of the frequency of 38kHz.

Consequently, because the toner particles may be floated over the sheet of the printed conductors, the adhesive forces acting to toner particles are greatly decreased.

As a result, the toner particles can be easily transported to the direction of the sense electrodes by the low level amplitude of the rectangular pulse voltages.

Not only sensing the toner particles are accomplished by the use of the CCD camera but also by the sense electrodes.

In the latter case, the charged toner particles of the center of the parallel sense electrodes are electrically caught at the upper electrode. Therefore the output signal due to toner particles is picked up from the sense electrodes.

After amplification of its signal, this output signal is sent to the analog input of the A-D converter in the personal computer.

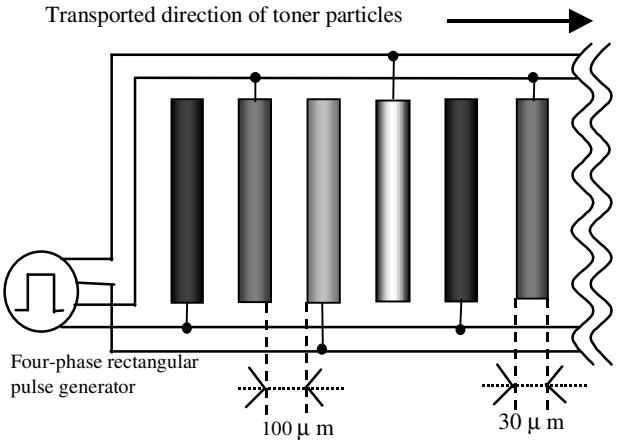

Figure 2. Outline of the sheet of periodical-array-conductors for transportation of toner particles driven by the four-phase rectangular pulse generator.

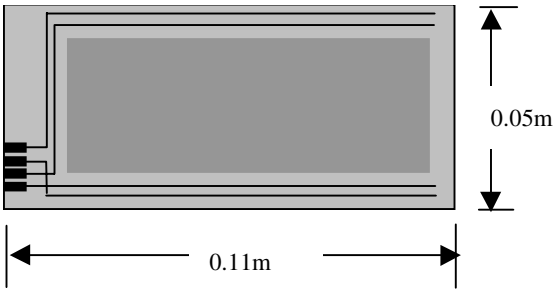

Figure 3. Photograph of the array conductors

Experimental Results

Figures 4 shows a typical example of the movement of toner particles driven by the rectangular pulses in the different positions.

Spherical toner particles with silica coating are used for this experiment.

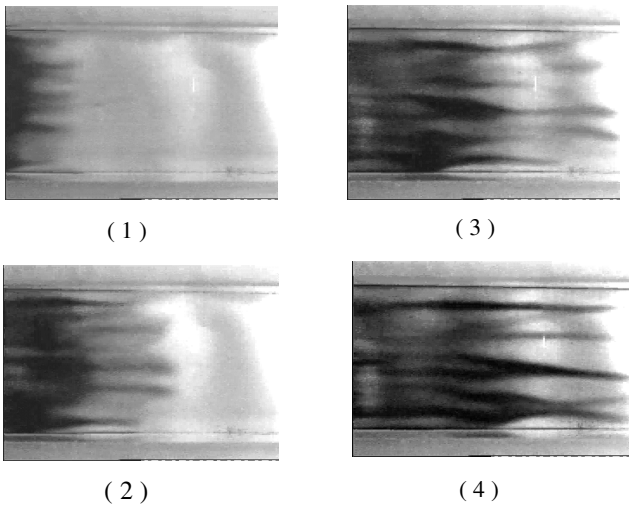

Figure 4. Typical examples of toner particles transported by four-phase rectangular pulses in the different positions.

The connection between the sheet of array conductors and the ultrasonic vibrator is done by the use of a sheet of either the glass or the expanded polystyrene as an interface.

Table 1. Relationship between the amplitude of the four-phase rectangular and the vibration effects

	100Hz	200Hz
No vibration	100v	100v
Vibration with glass	30v	35v
Vibration with the expanded polystyrene	24v	22v

Table 1 shows the relationship between the amplitude of the four-phase rectangular pulses and the vibration effects.

From this table, the expanded polystyrene plate put between the sheet of array conductors and the ultrasonic vibrator shows better transfer effect than the glass one.

Conclusions

In this research, the following results are obtained:

(1) By vibrating with the sheet printed periodic array-conductors for toner transportation, the amplitude of four- phase rectangular pulses can be greatly decreased.

(2) Toner particles adhered on the sheet of periodic array-conductors by the adhesive force can be almost removed by vibration.

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Biography

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