CHAPTER 3

EXPERIMENT

3.1 Materials

3.1.1 Conductive Toner: three types were used: Hitashi Meta, Tokyo, Japan

Table 3-1 Fundamental properties of sample toners used in this study.

Toner	Resistivity (Ω cm)	d (μm)
HMT 2059-1	4.4×10^8	11.8
HMT 2059-2	5.7×10^7	11.8
HMT 2059-3	7.4×10^6	11.7

3.1.2 Pulling electrode: ITO glass 100 mm. × 100 mm. × 1 mm.

3.1.3 Dented electrode: Stainless steel plate 100 mm. × 100 mm. × 2 mm.

3.1.4 Teflon sheet plate: 100 mm. × 100 mm. × 0.5 mm.

3.2 Apparatus

3.2.1 Toner Cloud Beam Control unit (home made) comprising five important units:

3.2.1.1 DC high voltage power supply: Bellnix Co.,Ltd. Saitama, Japan

Model: MHV 12 – 2.0 k, 1000 p

Input: + 10.8 ~ + 16.5 V

Output: 0 ~ + 2000 V, 1000 μA

3.2.1.2 Regulated DC power supply : PA 250 – 0.25 A/AL KENWOOD TMI Corporation, Japan

3.2.1.3 Regulated DC power supply : 532 C, Metronix Co.,Ltd. Tokyo, Japan

3.2.1.4 Pulling electrode

3.2.1.5 Dented electrode

3.2.2 Digital Camera: caplio. RR 30, Ricoh Co.,Ltd. China

3.2.3 Electrometer: R 8240 Digital Electrometer, Advantest Corporation, Tokyo, Japan

3.2.4 Electronic balance: AX 20S, Mettler Toledo Corporation, Osaka, Japan

3.2.5 Scanning Electron Microscope (SEM) : JSM 6400, JEO, Tokyo, Japan

3.2.6 Software Image Proplus, version 4.0.0.11 for windows 95/NT/98 number 41 N41000-26111, copyright 1993-1998, Media Cybernetics, Japan

3.2.7 Software ELFIN , copyright 1986-1998, ELFIN Corporation, Tokyo, Japan

3.3 Procedure

3.3.1 Experiment setup

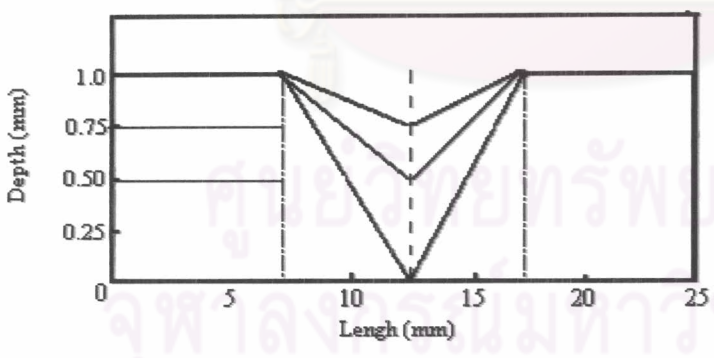
3.3.1.1 Preparation of four electrodes

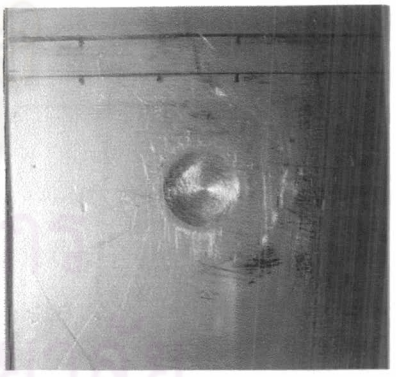
The electrodes used in the experiments are of a stainless steel and an ITO (Indium Tin Oxide) sputtered transparent glass. The ITO glass is used for

observing the toner motion. The ITO glass is flat and the stainless steel electrode is dented into three cone shapes. Diameter and depth of the dented electrode used in this study are given in Table 3-2. Figure 3-1 shows the shape of the dented electrode both the cross section of the dented shape electrode and the top view of the dented electrode.

Table 3-2 Diameter and depth of dented electrode.

Shape of dented electrode	Depth (mm)	Diameter (mm)
cone	0.2	10
	0.5	
	1.0	





a) Cross section of the dented shape electrode

b) top view of the dented shape electrode

Figure 3-1 The shape of dented electrode

3.3.1.2 Preparation of Toner Cloud Beam control unit (TCB)

A Toner Cloud Beam control unit is constructed as shown in Figure 3-2.

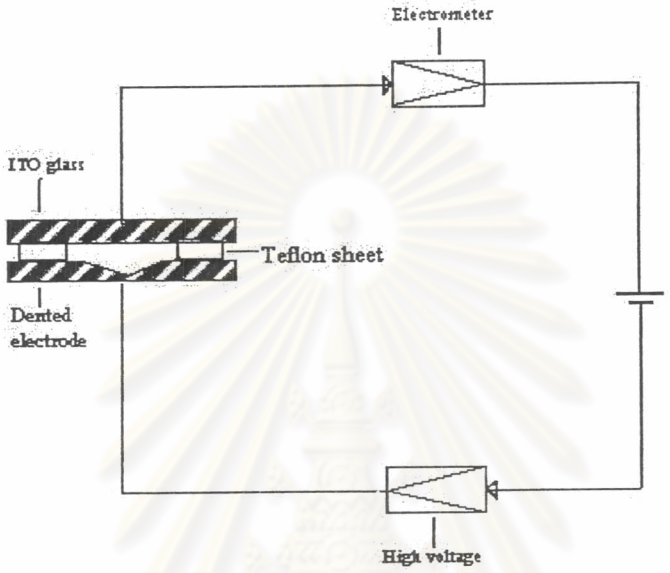


Figure 3-2 Schematic diagram of the TCB unit.

Two electrodes are used in this work, which are arranged in parallel. The upper electrode is an ITO glass and the lower electrode is dented called "the dented electrode". The spacing of the two parallel electrodes is arranged to be 0.5 mm by a teflon sheet. The teflon sheet is inserted to protect the electrodes from contact.

3.3.2 Toner confinement experiment.

3.3.2.1 Estimation of toner cloud extent.

Table 3-3 Voltage and the amount of conductive toner.

Depth of dented Electrode (mm)	Voltage (V)	Amount of conductive toner (mg)
0.2	500	0.3
0.5	750	0.5
1.0	1000	0.8
		1.0

a) A sample toner HMT 2059-1 weighed 0.30 mg is applied on the thin cone shape of the stainless steel electrode. The diameter and depth of the dented electrode are 10 mm and 0.20 mm, respectively. The voltages applied to the electrode are 500, 750 and 1000V within one second each.

Then photographs at the cloud state by a digital camera were taken, and toner could be viewed though ITO glass. Twice replica were taken for each experiment.

b) Toners HMT 2059-2 and HMT 2059-3 are each used in the place of toner HMT 2059-1 and the step a) are then repeated.

c) Toner at the toner cloud state is photographed. After that, the size of the toner cloud diameter was measured by the software Image - Proplus. Then the average value of the toner cloud diameter is taken and plotted in a graph to indicate the relation between the toner cloud diameter and the toner amount. This method give the dependency of the toner cloud extent on the toner amount. Again, the averaged value of the toner cloud diameter and its applied voltage is plotted to get the relationship

between the toner cloud diameter and applied voltage. Such a plot gives the dependency of the extent of the toner cloud on the applied voltage.

3.2.2.2 Evaluation of toner jumping current

The toner jumping experiment is set up by following the configuration shown in Figure 3-1. The toner is then applied to the lower electrode. The voltage is thereafter applied. The threshold voltage and toner jumping current at the initial jumping is determined.

a) Dependence of toner jumping current on the toner amount

The experimental step 3.3.2.1 is repeated to observe the toner jumping current detected by the electrometer

b) Dependence of toner jumping current on the applied voltage

The dependence of the toner jumping current on the applied voltage was studied using the cone shape of dented electrode with the depths of 0.2, 0.5 and 1.0 mm. The cone shape of the dented electrode is sprayed by applying the conductive toners coded HMT2059-1, HMT2059-2, and HMT2059-3 with the toner resistivity of 4.4×10^{8}, 7×10^{7} and 7.4×10^{6} Ω cm, respectively. The amounts of toner are 0.3, 0.5, 0.8 and 1.0 mg were used. The applied voltages used are 0 to 1000 V with an increment of 100 V and the spacing between the electrodes is 0.5 mm.

When the applied voltages have been set at 0 to 1000 V, the experimental procedures of step 3.2.2.2.1 are repeated. The toner jumping current is then measured by the electrometer.

3.3.3 Toner particle morphology

The conductive toner particle in Table 3.1 are subject to SEM technique for observations of toner shape and size.

3.3.4 Calculation of the toner jumping trajectory

The toner jumping trajectory is calculated by ELFIN software[10] in a personal computer. The element data is created by the ELF Bench in the software as shown in Figure 3-3.

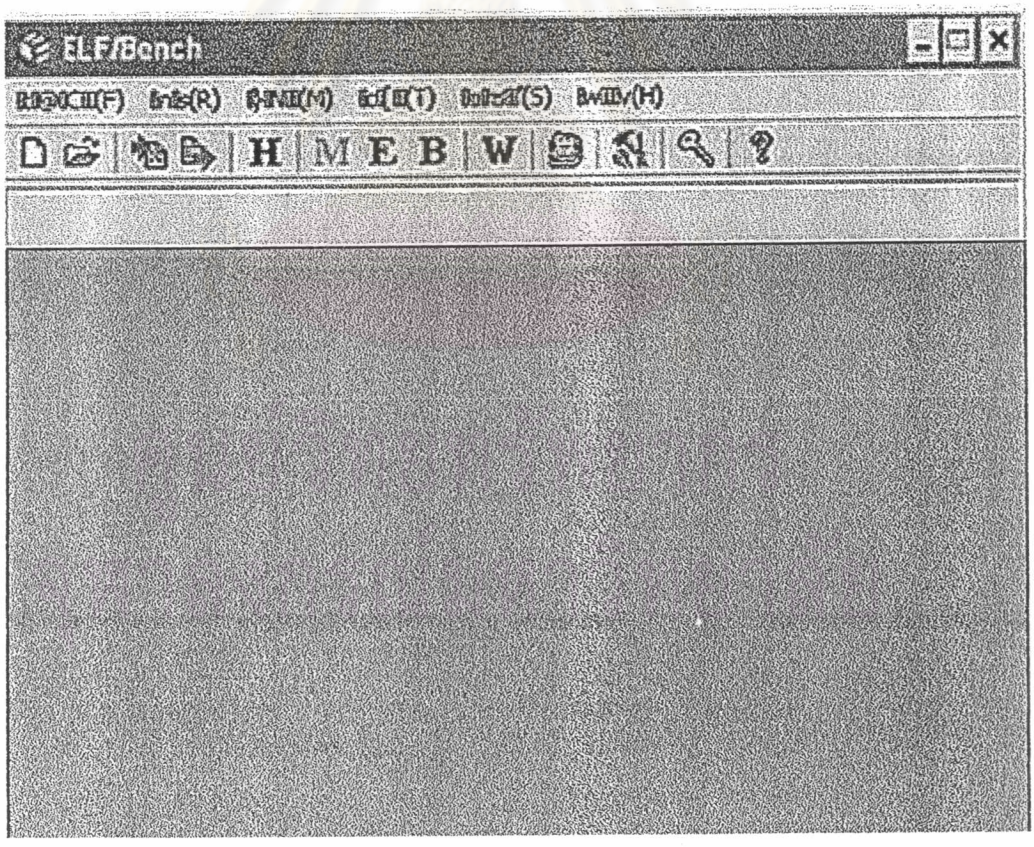


Figure 3-3 ELF/ Bench windows

The source program etest.mei (see Appendix B) in the H menu is used to create the element data. Both the previously mentioned source program etest.mai and the B menu are used to analyze the electric field. The toner jumping trajectory is finally calculated using the source program btest.mei in Appendix B. The positions X and Z resulted from the calculation are the toner jumping trajectory.