CHAPTER I

INTRODUCTION

The prime objective in cathode ray tube (CRT) manufacture is to make the best in picture qualities (*i.e.* resolution, sharpness, color purity, etc.) and to cut the production cost. The quality improvement and development are thus always in demand especially for the screening process that needs to be precisely controlled.

1.1 Cathode ray tubes (CRTs)

CRTs can be divided into two types :

1. Color picture tubes (CPTs) for color television system
2. Color display tubes (CDTs) for color computer system

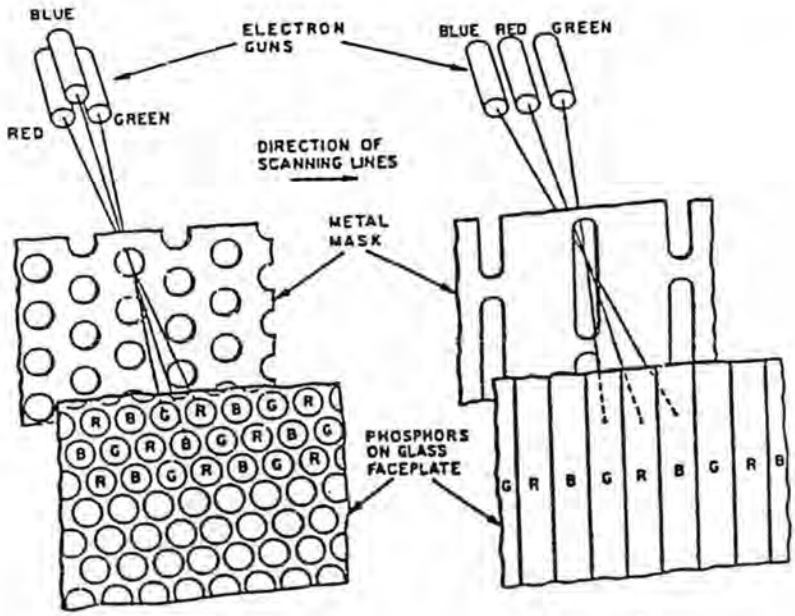

Figure 1.1 Schematic of two screen and shadow mask systems **a**) for CDTs system and **b**) for CPTs system.[1]

The red, green and blue picture signals are applied to the electron guns marked R, G and B, respectively, and all three electron beams from the guns scan the phosphor screen together. However, the screen consists of triads of dots of three different phosphors and, between the guns and the screen, a metal plate with holes (called the shadow-mask) which ensures that the electron beam from gun R lands only on phosphor dots that produce red light, that from gun G only on dots producing green light, and that from gun B only on dots producing blue light.

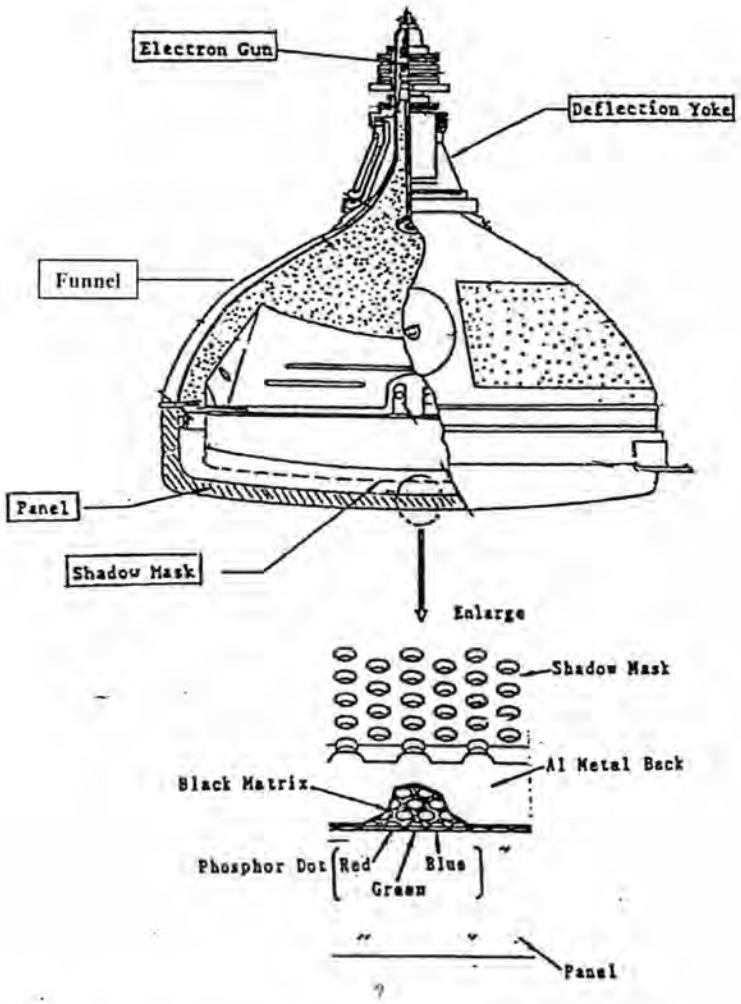

Figure 1.2 CDT tube structure

1.2 Phosphor screens

The phosphor is a powder containing particles which have a wide distribution of sizes, usually between 1 and 30 μm. In CRTs, phosphors are used as a transducer of electrons to visible light. Layers of these particles make up screen in CRTs. ZnS:Ag is a phosphor for blue color, ZnS:Cu,Al is for green and Y_2O_2S:Eu is for the red.[a]

A phosphor screen is formed by coating in a glass with a water-based mixture containing solid phosphor particles, various surfactants, PVA, and ammonium dichromate (ADC; a photosensitizer). After the coated screen is exposed to UV light in designated areas, the ADC crosslinks the PVA rendering patterned water-insoluble film. Following this, a water spray is applied to wash away the soluble uncrosslinked areas to leave the insoluble crosslinked areas remain on the glass producing the desired phosphor dots. This process is then repeated 3 times to form a pattern of blue, green and red dots on the screen.

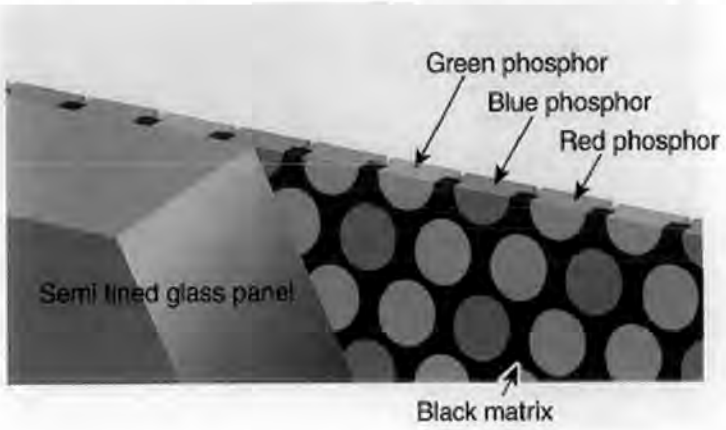

Figure 1.3 Phosphor screen structure of CDTs [b]

Notes : [a] *Refer to TDDT newsletter (3rd edition, 1996).*
[b] *Refer to Toshiba corporation's pamphlet (1999).*

1.3 The requirements of a good quality phosphor screen

In screening phosphor powder, there are many factors which must be kept under control. Because these factors are mutually correlated with each other and should not be considered separately with regard to its effect on the final result. The quality of the phosphor screen depends largely on the photochemical reaction of PVA (poly(vinyl alcohol)) resin underneath phosphor particles on panel substrate which depends considerably on particle size distribution, surface conditions of phosphor particles, dispersers added, pH of PVA-phosphor slurry, UV light intensity and profile, exposure and development conditions of dried PVA-phosphor screens.[2]

From the above dependence, the characteristics of a good quality phosphor screen can be summarized as follows.[2]

1. Optimum arrangement of phosphor particles
2. Good phosphor slurry preparation
    2.1 Good pH controlled of slurry
    2.2 Optimum number of layers of particles
3. Good scattering of UV light
4. Good control in optical roughness of particle surface
5. Optimum development conditions of dried PVA-phosphor screens

Items 1 to 2.1 are controlled by phosphor preparation. Items 2.2, 3 and 5 are controlled by screening process.

At present, screen quality is although acceptable in most cases, it will however hardly satisfy future customers in the strong competitive CDTs market. Together with high cost in production process, most manufacturers thus always look for improvement and development in their production.

In 15 inches CDT process, there are ~ 2,700,000 screen dots on 1 screen.[a] These dots must be uniform in size and meet the specification (160 ± 5 μm, Figure 1.4).[b] However, dot size sometimes does not meet the specification and its physiochemical details have not been well understood. This can create disturbing

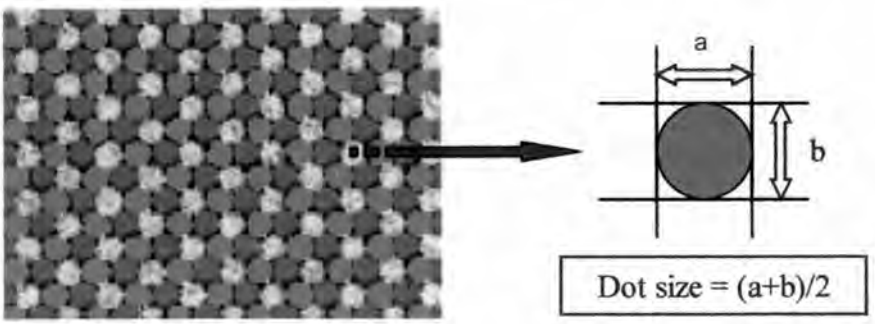

Figure 1.4 a) Dotted phosphor screen of 15 inches CDT system[a]

b) Diameter of dot size measurement[b]

variables in the screening process which causes defects to products and leads to high cost. The effect from pH of the phosphor slurry in the preparation step is one of the most important factors not previously investigated in our screening process.

Notes : [a] *Refer to TDDT newsletter (3rd edition, 1996).*

[b] *Refer to TDDT work instruction No. 14-05-098.*

1.4 Purpose of research

The purpose of this research is to study the relationship between pH and screen dot size from crosslinking reaction of poly(vinyl alcohol) in green phosphor slurry.

1.5 Scope of research

In this research, dot size from crosslinking reaction of green phosphor slurry at various pH were measured. However, as all the factors in screening process are highly correlated, other factors such as exposure amounts and other slurry conditions were adjusted to find out an improved condition for preferred screen quality. Besides dot size, other screen qualities such as dot adherence, sharpness, pin hole, brightness and white uniformity were also inspected.