U

COLOR WRITE-THRU DIRECT VIEW STORAGE TUBES

By

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Write-thru in a Direct View Storage Tube (DVST) is achieved by adjusting the refresh vector speed and beam current of the 6 kV writing beam so to not cause the phosphor surface to charge positive and luminesce under low voltage (<300 V) electron bombardment (1). The write-thru image allows refresh capabilities for interactivity and faster response in the DVST. However, present DVST's are, monochrome, P-1 targets, and the viewer has difficulty in discerning the refresh image from the stored image. Color discrimination has been shown to improve information retrieval (2). In order to achieve color discrimination, DVST phosphor improvements were made so that an admixture of modified P-1 and P-22R (Y_2O_2S:Eu) phosphors gave the desired color shift results (Figure 1). This DVST has recently been discussed (3) and the phosphor materials used for the DVST target will be discussed in this presentation.

Addition of P-22R to the DVST P-1 target reduces the green storage brightness and color purity of the DVST stored image. Therefore, materials were developed to 1.) increase green stored brightness with 2.) no loss of color purity by addition of a P-22R phosphor. The red emission was eliminated by creation of a low voltage dead layer on the P-22R phosphor. This dead layer was achieved by forming a YPO_4 surface and by oxydizing the oxysulfide phosphor surface (4). The phosphate coating reduces the 300 V luminous efficiency (5) by an order of 10 over the oxydized oxysulfide phosphor. At the same time the phosphate coating increases the writing threshold (WT) voltage of the target (Table I).

300 V luminous efficiency and operating voltages, i.e., WT, upper writing limit (UWL), and operating range (OR) (6), change as the phosphor undergoes electron bombardment. As is shown in Table II, the phosphate coating makes considerable difference in the P-22R phosphor WT aging rate. Likewise, the fast WT aging rate of the P-1 phosphor can be decreased by alloying the P-1 phosphor with MgO (7). The MgO alloying does not seem to effect the 300 V electron aging of the P-1 luminous efficiency. Both age in an exponential manner with similar slopes.

Although the MgO alloying of the P-1 phosphor reduces its 300 V luminous efficiency, the reduction in WT aging rate was such that more current could be added to the target. When admixed with the phosphate coated P-22R, the target WT was increased so to offset any loss in stored brightness (Table III). By redesigning the flood gun system to increase current to the 19" DVST target, an increase in stored brightness is obtained. Also, by bringing the flood guns closer to the DVST target, fewer electrons are lost to wall bands and a brighter yet stored image is observed - plus, the new feature of color write-thru.

1) Virgin, L., Langford, D., and Penn, C.; "Write-Thru on Direct View Bistable Storage Tubes", IEDM Digest, Washington, D.C , December 1977, p 268

2.) Martin, A.; "The CRT/Observer Interface", Electro-Optical Systems Design, June 1977, p. 35.

3.) Woody, T.; "A Color Write-Thru DVST", presented at the 1981 Society for Information Display International Symposium, New York, NY.

4.) Gutzler, D.; "The Efficiency of the Y_2O_2S Tb Under Low Energy Electron Bombardment", Journal Electrochemical Society, Vol. 126, No. 4, (1979), p. 571.

5.) Petersen, R.O.; "Low Voltage (~300 V) Cathodoluminescence of Common CRT Phosphors", Electrochemical Society extended abstract, May 1980, p 528.

6.) Anderson, R.H.; "A Simplified DVBST", IEEE Transactions on Electron Devices, Vol. ED-14, No. 12, p. 838 (1967)

7.) Woody, T.; "Improved Phosphor Life in Direct View Storage CRT's", SID Digest, 1978, p. 118.

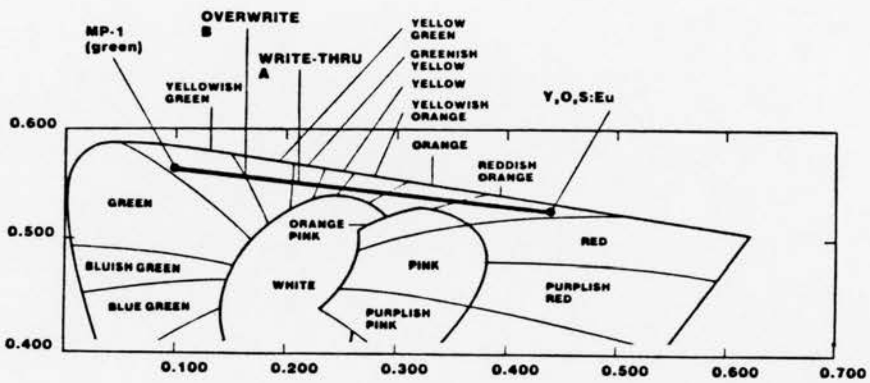


Figure 1

Section of 1976 CIE-UCS Chromaticity Diagram
Showing Write-Thru Color Shift

Table I

Effect of Phosphate Coating on Y_2O_2S Eu
Phosphor Writing Threshold and 300 V Efficiency

Surface State	Target Deposition & Bake	%P	WT (Volts)	300 V Eff. (L/W)
As Etched	Organic Sol., N_2	0	105	1.51
As Etched	PVA, 510°C Air	0	160	0.17
As Coated	PVA, 510°C Air	0 20	245	0.01
As Recv'd	PVA, 510°C Air	0.10	230	0.03

Table II

Coulombic Aging of Color Write-Thru DVST Phosphor Material

Materials*	Initial 300 V Eff. (L/W)	Δ ln 300 V Eff. / $\Delta C/cm^2$	Initial WT (Volts)	$\Delta WT / \Delta C/cm^2$	Initial OR (Volts)	C/cm^2 Required for OR → 0
P-1	1.25	-0 0142	182	+8.68	42	7.2
MgO Alloyed P-1	0.90	-0 0153	175	+1.36	15	48 0
Etched P-22R	0.17	0	160	+1.39	10	7 2
.2%P Coated P-22R	0.01	0	245	-0.44	60	OR Always Increasing
33% MgO Alloyed P-1 67% .2%P Coated P-22R	0.59	-0.0122	245	+0.967	55	142.5

* All materials PVA deposited, baked at 510°C in air.

Table III

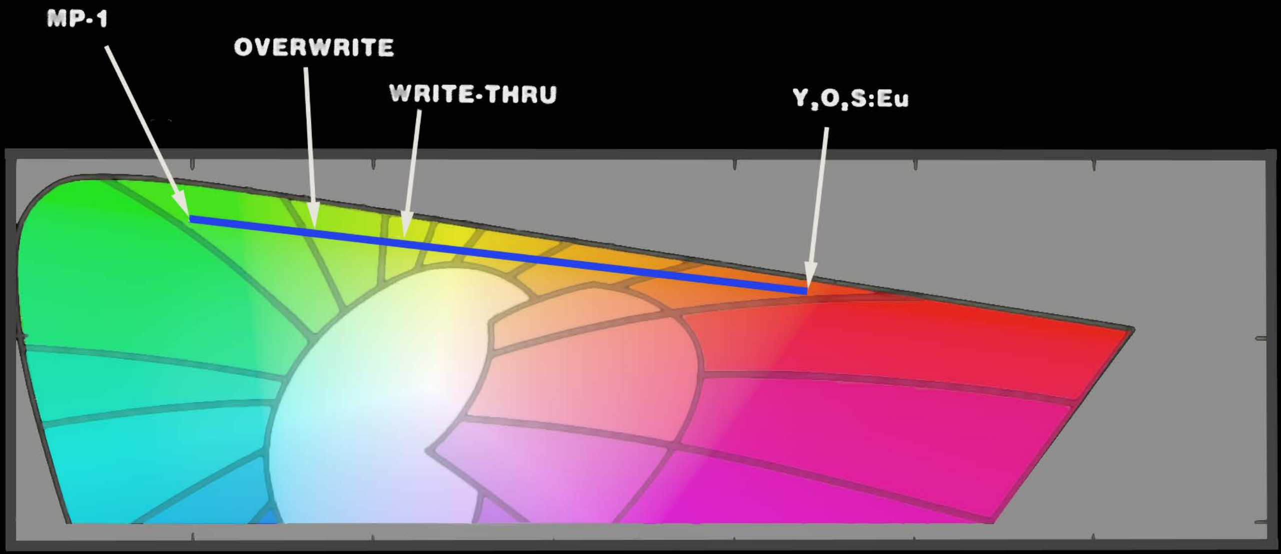
Comparison of 19" DVST Performance

Target	Funnel Type	Screen Current (mA)	Avg. Min. Stored Brightness (f-L)
100% MP-1*	90°	~60	8
33% MP-1 67% MP-22R**	90°	~60	8
33% MP-1 67% MP-22R	90°	~80	9
33% MP-1 67% MP-22R	100°	~120	15

* MP-1 is MgO alloyed P-1

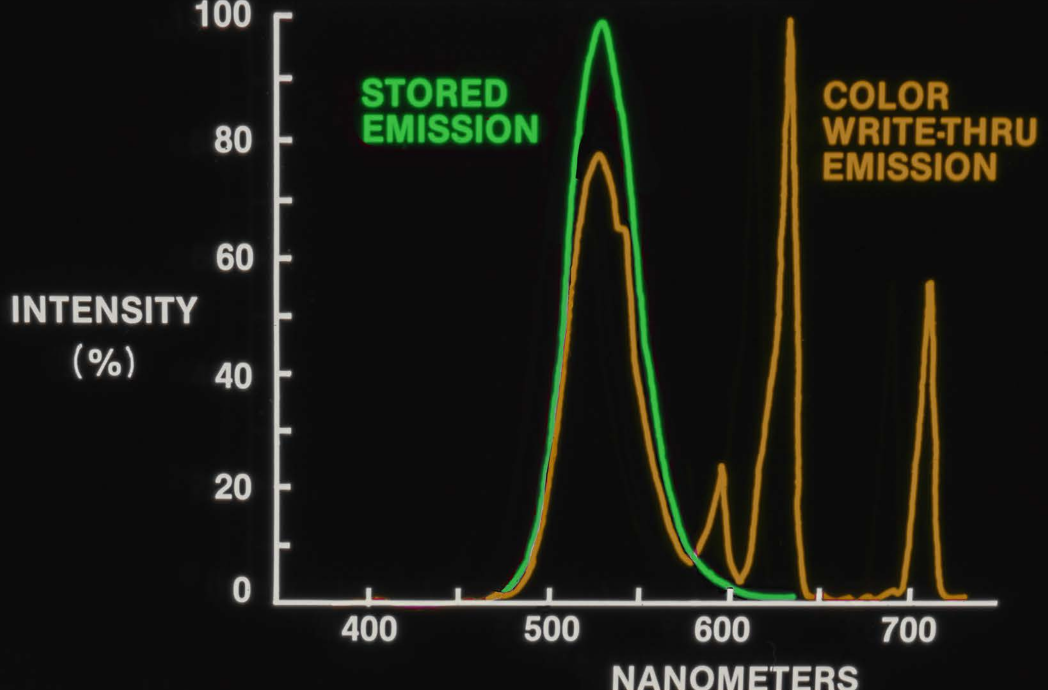
** MP-22R is phosphate coated Y_2O_2S Eu

Figure 1 Color Write-thru Color Shift



CHROMATICITY DIAGRAM

Figure 2 Stored and CWT Emission Spectra



EMISSION SPECTRA

Table I

Effect of Phosphate Coating on Y_2O_2S:Eu Phosphor Writing Threshold and 300 V Efficiency

SURFACE STATE	TARGET DEPOSITION & BAKE	PHOSPHATE (%)	WRITING THRESHOLD (VOLTS)	300 V EFFICIENCY (L/W)
As Etched	Organic Solvent (N_2)	0	105	1.51
As Etched	PVA, 510°C Air	0	160	0.17
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Table II

Coulombic Aging of Color Write-Thru DVST Phosphor Material

Materials*	Initial 300 V Eff. (L/W)	$\Delta \ell n$ 300 V Eff. $\Delta C/cm^2$	Initial WT (V)	ΔWT $\Delta C/cm^2$	Initial OR (V)	C/cm^2 Required for OR → O
P-1	1.25	−0.0142	182	+8.68	42	7.2
MgO Alloyed P-1	0.90	−0.0153	175	+1.36	15	48.0
Etched P-22R	0.17	0	160	+1.39	10	7.2
0.2%P Coated P-22R	0.01	0	245	−0.44	60	OR always increasing
33% MgO Alloyed P-1 67% 0.2%P Coated P-22R	0.59	−0.0122	245	+0.967	55	142.5

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33% MP1 67% MP22R	90º	~80	9
33% MP1 67% MP22R	120º	~120	15

* MP1 is MgO alloyed P1 Phosphor

** MP22R is phosphate coated P22R Phosphor

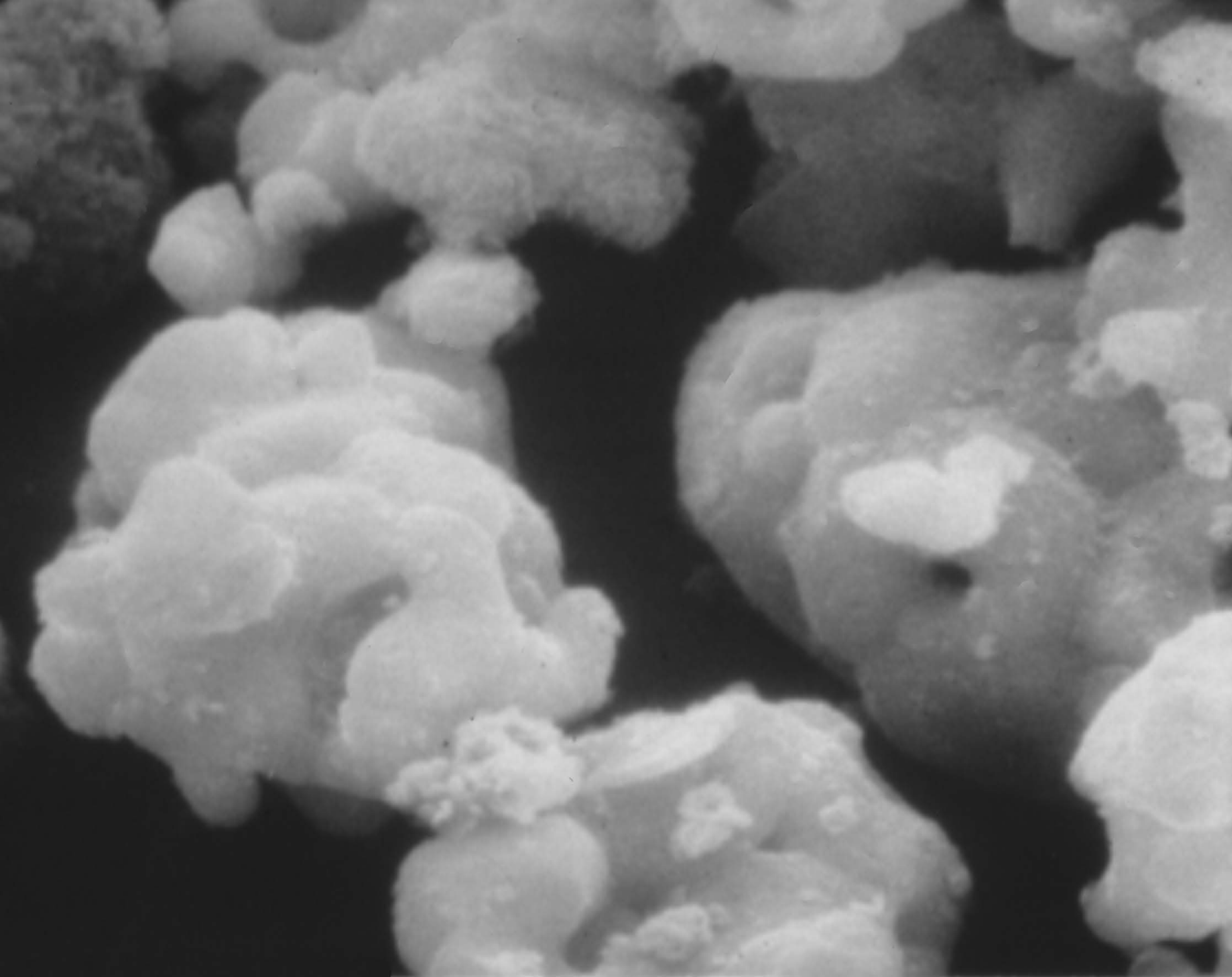

Figure 3

Tektronix

MP1

Phosphor

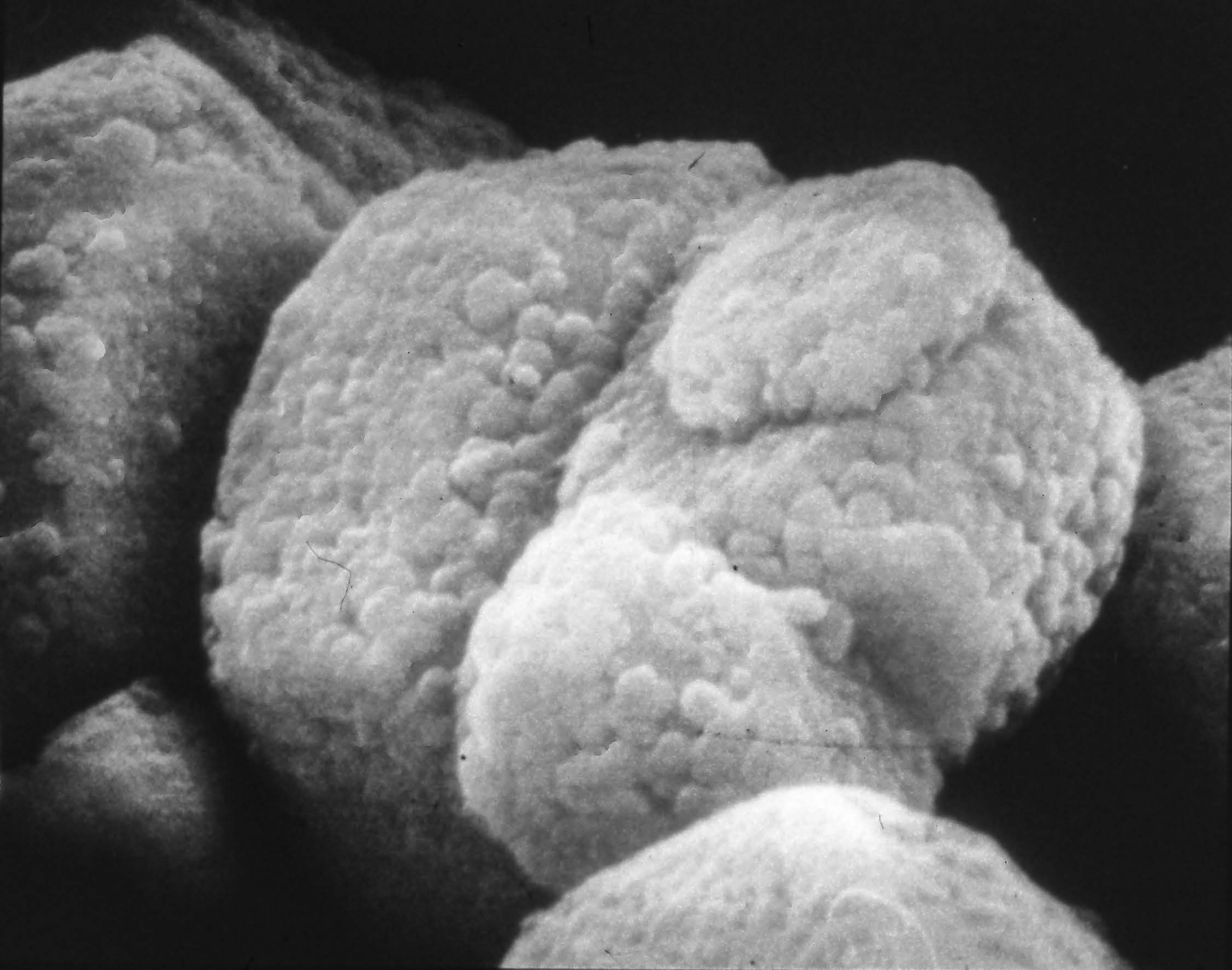

Figure 4

<u>Tektronix</u>
MP22R
Phosphor

1 μ