Storage Phosphor Screens

Screens for storage phosphor imaging systems

Storage Phosphor Screens are used in conjunction with a storage phosphor system, such as Typhoon™ Variable Mode Imagers, Storm™ Gel and Blot Imaging Systems, and PhosphorImager™ instruments. Storage Phosphor Screens retain energy from beta particles, X-rays, and gamma rays, and require exposure times that are 50–90% shorter than that of conventional film. Upon laser-induced stimulation, light is emitted from the storage phosphor screen in proportion to the amount of radioactivity in the sample.

The resulting digital image allows for quantitation of subtle signal intensity differences over the wide dynamic range of the system and for production of publication-quality images. Latent images are erased with the ImageEraser, a white light source. Screens are reusable and are not degraded by repeated exposure to laboratory levels of radioactivity.

Screen types

General purpose

General purpose screens are reliable for a wide variety of applications and can be used with ^{32}P, ^{125}I, ^{35}S, ^{33}P and ^{14}C. The durable cellulose acetate coating and the phosphor layer formulation makes the GP screen ideal for ^{32}P and ^{125}I detection and quantitation. This is the screen of choice for ^{32}P Northern blots, Southern blots, ^{125}I Western blots, and gels.

Tritium

To detect the weak energy of the ^{3}H signal, Tritium (TR) screens are constructed without the protective cellulose acetate overlay. The maximum energy range of ^{3}H is 5 microns and that signal can be further attenuated by a thick sample or sample media.

A sample prepared with a fluorographic reagent is not recommended. Best results are obtained when the ^{3}H signal is on the surface of the sample and available to penetrate the screen (for example, tissue sections on glass and whole body autoradiography).

Screen styles

Two types of screen configurations are available. Mounted screens are permantly fixed to an aluminum backing plate, and they require a specially designed exposure cassette. Unmounted screens have no additional backing and can be used with a standard exposure cassette.

PhosphorImager Systems (other than Storm and Typhoon) require the use of mounted screens. Storm and Typhoon Systems, with their lid pressing mechanism, can use mounted or unmounted screens.

Detection threshold

The lower limit of detection for a 1-h exposure is less than 2 dpm/mm^2 for ^{14}C using the GP screen scanned at 200 µm.

Excitation

Creation of excited (stored) electrons occurs when the screen is exposed to wavelengths shorter than 380 nm or to α, β, or γ radiation.

Erasure

Approximately 80% of stored information is released upon scanning with the Phosphor Imager. The remaining signal must be erased before the Storage Phosphor Screen is reused. As shown by the stimulation spectrum (Fig 3), the most efficient wavelengths of erasing light are between 475 and 650 nm.

For example, using a 500 W photoflood tungsten light bulb and a yellow filter (Wratten 16), an exposure of 10 J/cm^2 will leave a residual signal level of less than 10^{-5} of the original exposure level.

Amersham Biosciences

Screen selection guide

Instrument compatibility		PhosphorImager Models: 400, 425, 445, PSI and PSF Storm and Typhoon Systems Models: 820, 830, 840, 860, 8600, 92X0, and 94X0	Storm and Typhoon Systems Models: 820, 830, 840, 860, 8600, 92X0, and 94X0
TYPE		**GP (mounted)**	**GP (unmounted)**
Small Phosphor Screen 20 x 25 cm	screen & cassette	63-0034-89	63-0034-86
	screen only	63-0034-88	63-0034-87
Large Phosphor Screen 35 x 43 cm	screen & cassette	63-0034-82	63-0034-79
	screen only	63-0034-81	63-0034-80
Tritium Screen 19 x 24 cm	screen only	63-0035-50	63-0035-49
	screen kit	63-0035-51 (1 mounted, 4 unmounted)	

GP (general purpose screen) – for use with ^{125}I, ^{32}P, ^{33}P, ^{35}S and ^{14}C

Performance properties of storage phosphor screens.

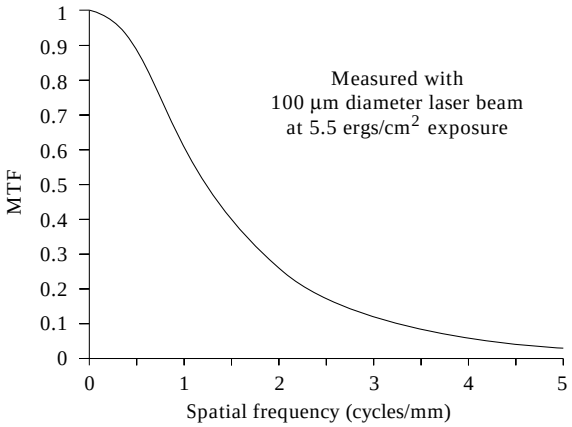

Fig 1. Screen resolution.

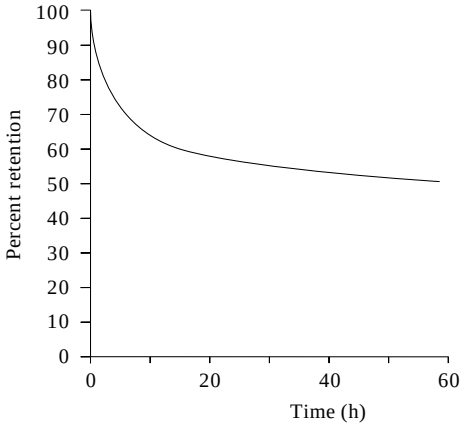

Fig 2. Latent image retention. Greater than 90% of the stored energy is available two minutes after exposure, and greater than 50% remains up to 24 h.

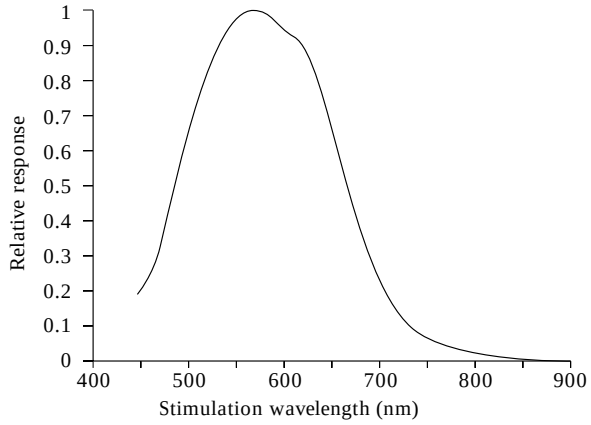

Fig 3. Stimulation spectrum. Stimulation is the process of releasing the stored information. Phosphor Imaging Systems use a red laser light source to deliver greater than 2 mW to the sample.

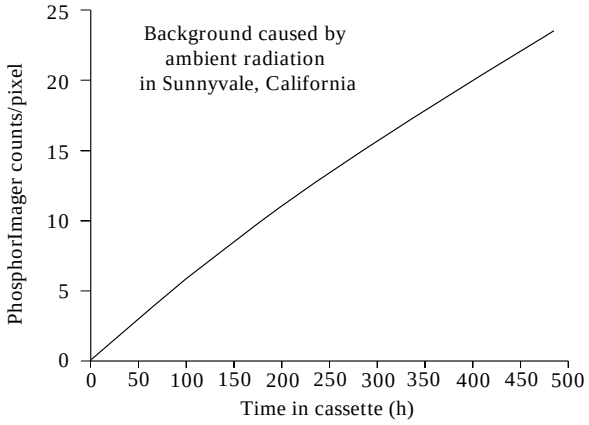

Fig 6. Ambient radiation background effect. Screens were erased and then stored at room temperature in the exposure cassette prior to scanning. Ambient radiation is assumed to be environmental gamma rays.

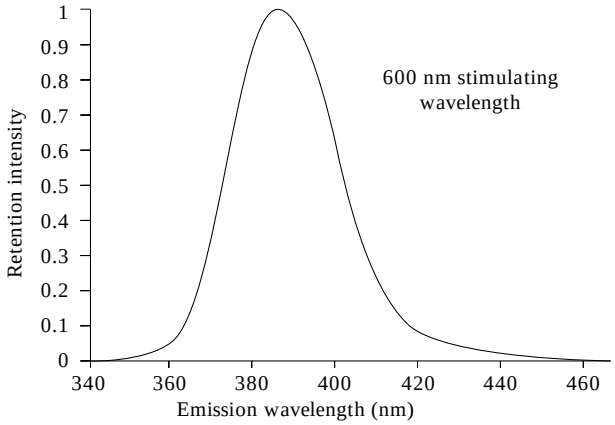

Fig 4. Emission spectrum.

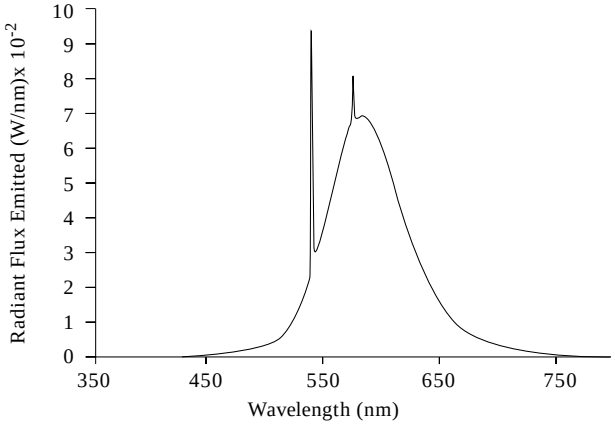

Fig 7. Image eraser lamp output.

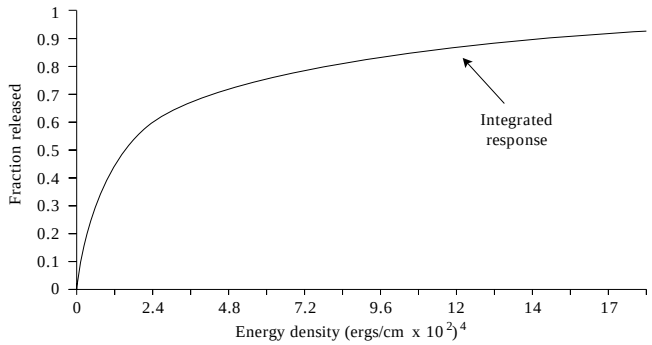

Fig 5. Stimulated fluorescence decay. The post stimulation decay has a time constant less than 1 µs. This shows a fraction of stored information released by red laser stimulation.

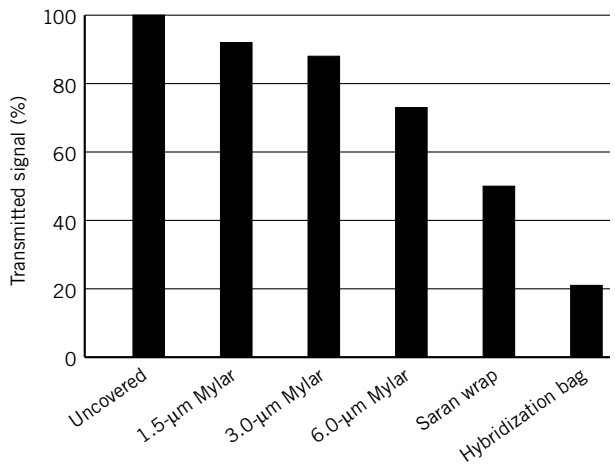

Fig 8. Effects of covering radioactive samples.

Coverings

To prevent contamination, radioactive samples are covered prior to their exposure to the Storage Phosphor Screens. There are a variety of materials used for this purpose (Fig 8).

Mylar™ provides the best transmittance for ^{14}C particles followed by Saran™ wrap and then a hybridization bag. The thinner Mylar allows more transmittance. However, as the thickness of the Mylar decreases, the chances of screen contamination increase. Therefore, unless it is pertinent to get as much signal as possible, a Mylar thickness of 6 µm should be used to ensure that the screen does not get contaminated. Also, the 6-µm Mylar is easier to handle than the 1.5-µm and 3-µm versions.

Physical properties

Test conditions for storage stability: 25–49 °C with 20–90% relative humidity.

Results: Storage Phosphor Screens are highly resistant to the effects of high relative humidity. Representative screens have been incubated at 32 °C/90% relative humidity for up to one year with no detectable loss in sensitivity or change in physical properties.

Test conditions for scratch resistance: 0.08 mm stylus and 25–200-g load

Results: Visible damage to the overcoat occurs when a load exceeding 50 g is applied to the stylus. Damage to the phosphor layer, seen radiographically, occurs when the load applied to the stylus exceeds 100 g.

Flatness

Screens are manufactured to be flat under conditions of 21 °C and 50% relative humidity. Actual flatness will vary with temperature, relative humidity, and screen size. The aluminum mounting plate is flat to 0.005 inches.

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