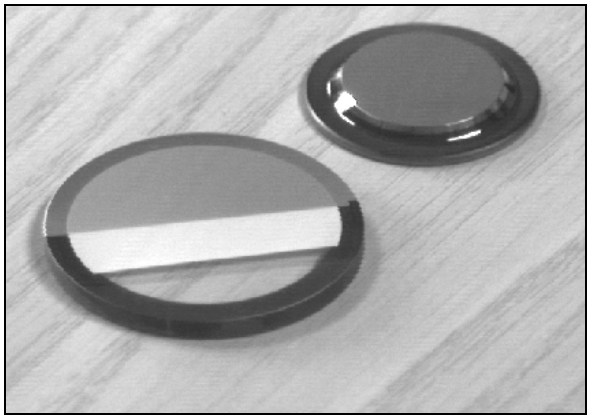
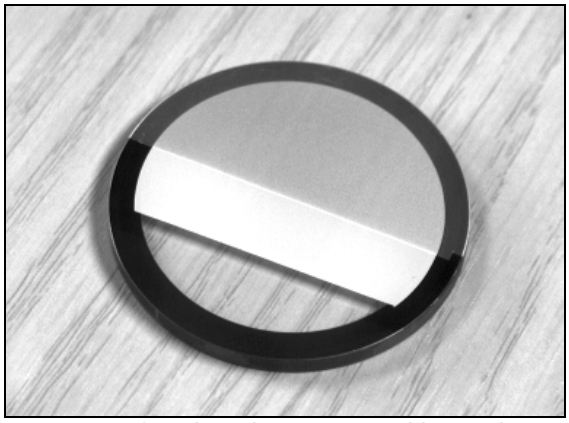
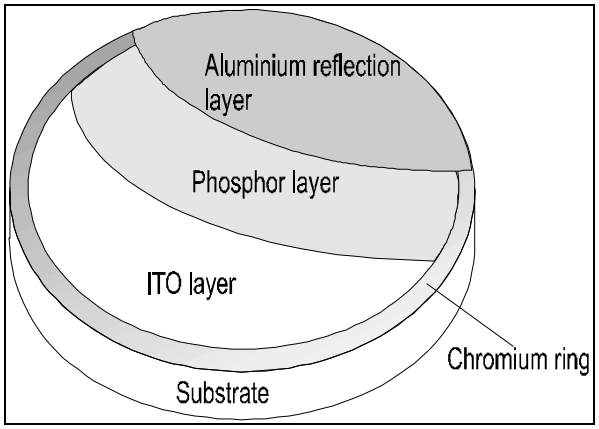
PROXITRONIC

Phosphor Screens



Taper and glass substrates with phosphor layer.





Structure of a phosphor screen with ITO base coating, chromium ring, phosphor layer and aluminium reflection layer.

Applications

- Electron Microscopy
- MCP Detector Systems
- X –Ray Detection
- UV and Electron Detection
- Beam profile analysis

Features

- P43, P46, P47, P11 and other Scintillators
- ITO, Chromium, Aluminium, Water Glass coating
- Segmentation of the coating area possible
- 5 mm - 250 mm diagonal, bigger on request
- On any plain and rigid surface (Metal, Glass, Plastic)
- Coating of special forms like prisms, tapers and others possible
- Coating of all line and area CCD elements without CCD protection window
- Coating thickness up to 100µm

Preparation and Features

As a manufacturer of image intensifiers and low light cameras, PROXITRONIC also offers phosphor screens which allow the two-dimensional, visual detection of electrons, charged particles, x-rays and UV-radiation.

The phosphor coating is prepared by sedimentation of phosphor grains on a substrate (plain glass, quartz, fibre optic block or taper, CCD chip, prism, metal) usually provided by our customers. Our sedimentation process leads to a very homogeneous layer structure. Please note that the coatings are very sensitive to mechanic stress, e. g. a light touch with a finger immediately destroys the surface. Nevertheless, the removal of dust or small particles is possible by simply blowing them off with a jet of dry air or nitrogen.

To guarantee a homogeneous layer structure, at least 3 to 4 layers of phosphor grains are necessary. The minimum average grain size available is 1 µm. Bigger grains and an increased layer thickness do improve the quantum efficiency while simultaneously efficiency is reduced.

The resolution limit R_L is defined as the spatial frequency resulting in a modulation transfer function MTF with a value of 3 %. R_L is measured in *linepairs/mm* (*lp/mm*) and can be approximated as

$$R_L = 500/D$$

with D as the thickness of the phosphor layer in µm. The maximum thickness of the phosphor coating is limited technically to ca. 100 µm.

The screens are stable under vacuum conditions and can resist temperatures up to 400°.

As a standard, coatings up to 250 mm can be manufactured. Larger screen sizes are possible on request.

Standard Phosphor Types

Three criteria allow the choice of the most suitable phosphor type:

- efficiency
- emission spectrum
- luminescence decay time

The standard phosphor types are:

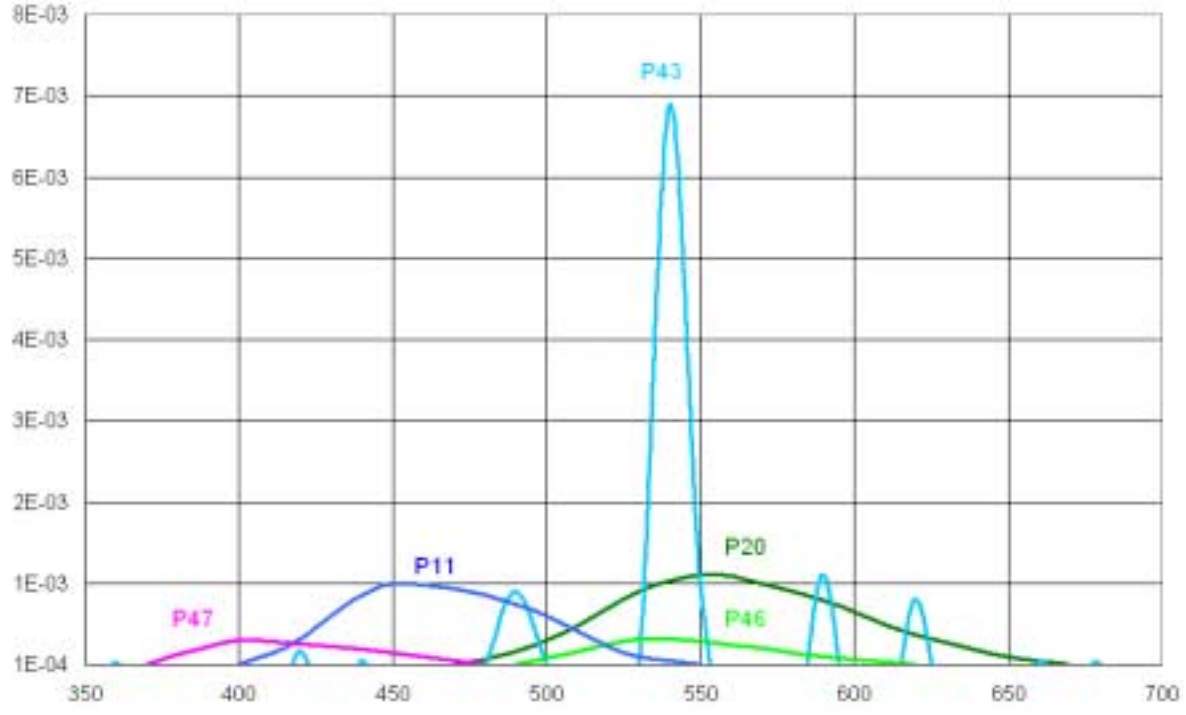
Type	**Composition**	**Light Emission**				**Decay Time**	
		Range		Maximum	Color	Decay of Light Intensity	
		from	to	typically at		from 90 % to 10 % in	from 10 % to 1 % in
P 43	Gd_2O_2S:Tb	360 nm	680 nm	545 nm	green	1 ms	1,6 ms
P 46	$Y_3Al_5O_{12}$:Ce	490 nm	620 nm	530 nm	yellow green	300 ns	90 µs
P 47	Y_2SiO_5:Ce,Tb	370 nm	480 nm	400 nm	blue white	100 ns	2,9 µs
P 20	(Zn,Cd)S:Ag	470 nm	670 nm	550 nm	yellow green	4 ms	55 ms
P 11	ZnS:Ag	400 nm	550 nm	450 nm	blue	3 ms	37 ms

Efficiency does not only depend on the type of phosphor but also on parameters like grain size, layer thickness, aluminium reflection layer and special manufacturing parameters like thermal processing. It can be reduced by the presence of alkali ions.

Type	Efficiency (lm/µA)				Efficiency (W/mA)				Efficiency (ph/el)			
	6kV	10kV	12kV	15kV	6kV	10kV	12kV	15kV	6kV	10kV	12kV	12kV
P 43	0,24	0,43	0,54	0,71	0,43	0,77	0,97	1,28	185	330	420	550
P 46	0,08	0,15	0,19	0,25	0,22	0,39	0,49	0,65	90	160	200	265
P 47	0,06	0,11	0,14	0,18	0,62	1,35	1,71	2,24	212	380	480	630
P 20	0,25	0,45	0,57	0,75	0,59	1,05	1,33	1,74	240	430	115	715
P 11	0,06	0,10	0,13	0,17	0,56	1,00	1,26	1,66	200	360	455	600

Efficiency of phosphor screens in proximity focus image intensifier diodes exposed to 6 keV, 10 keV, 12 keV and 15 keV electrons (screen thickness ca 4-5 µm, grain size ca. 1 µm, aluminium reflection layer). Please note that these screens are sedimented on fibre optic plates, which means that with plain glass the efficiency will be even 40 % higher.

Energy Conversion ((W/nm)/W)



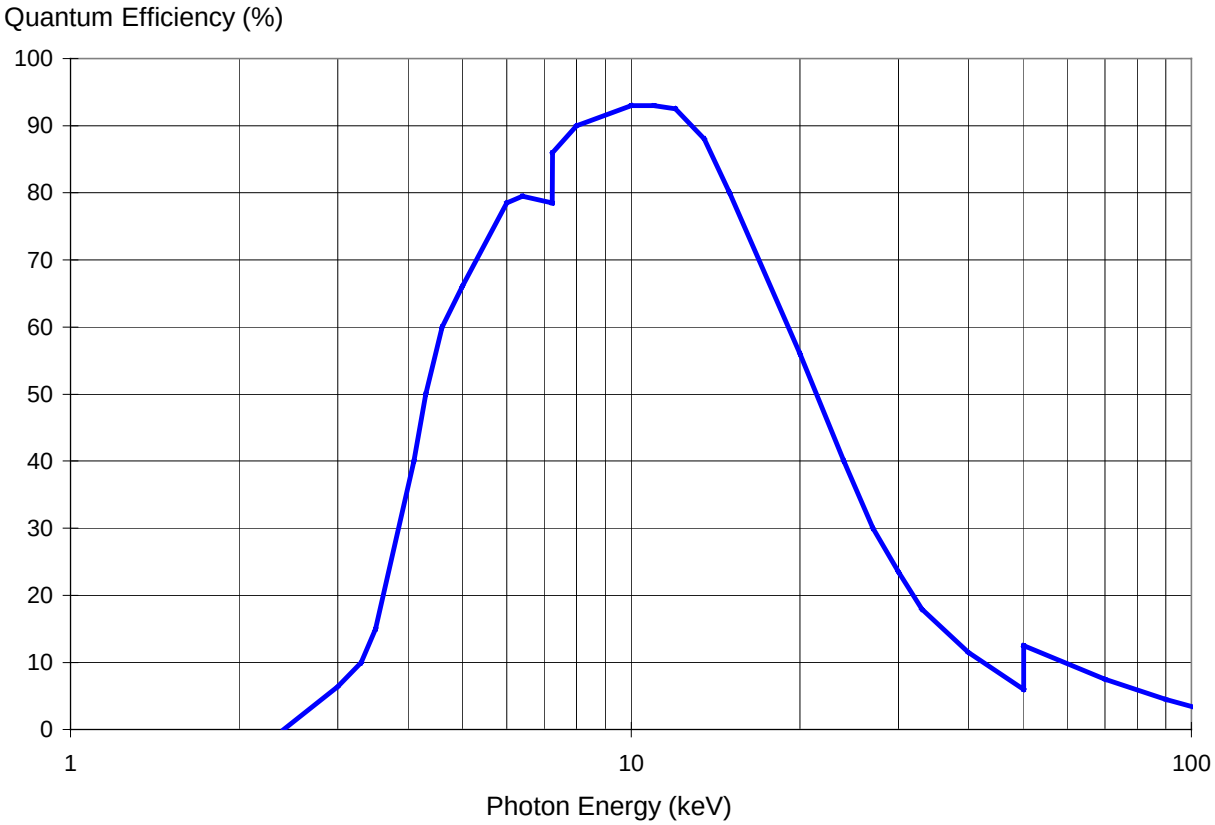
Wavelength (nm)

Except these 5 standard phosphor types, any luminescent which is sedimentable can be utilised to manufacture a screen on special request.

Phosphor Types for UV and X-Ray Detection

For the conversion of UV radiation of 250 nm to 300 nm into visible light (green), P20 is the phosphor of choice.

P43 is most recommended for the complete x-ray spectrum and UV radiation of a wavelength ≤ 250 nm.



Quantum efficiency of P 43 (phosphor quantity: 25 mg/cm^2, layer thickness: ca. 55 µm)

Apart from that, there is a multitude of UV and x-ray sensitive luminescents. For further information, please contact

Riedel-de Haën
Postfach 10 02 62
D 30918 Seelze
Phone: ++49 / (0) 51 37 / 999-0
Fax: ++49 / (0) 51 37 / 999-123

Options

- **ITO Layer**
  PROXITRONIC offers a conducting base coating with indium tin oxide (ITO) to reduce electrostatic effects on the screen caused by electrons and ions. The ITO coating is also well known under the name NESA coating. Standard and special conductive parameters can be achieved.
- **Chromium Ring (Diameter < 100 mm)**
  To allow direct electric contact to a phosphor screen, a chromium ring of width up to 100 mm diameter can be sputtered on the outer area of the substrate. This does reduce the area of the phosphor down to the inner diameter of the chromium ring.
- **Wolfram Ring (Diameter > 100 mm)**
  To allow direct electric contact to a phosphor screen for substrates with diagonal > 100 mm, a wolfram ring can be sputtered on the outer area of the substrate. This does reduce the area of the phosphor down to the inner diameter of the wolfram ring.
- **Aluminium Reflection Layer**
  To increase light efficiency by up to 100 % and to reduce stray light, it is advantageous for most applications to seal the phosphor coating with an aluminium layer on top of it. As a standard, a 40 nm to 50 nm coating is recommended, but on special request the thickness can be varied between

5 nm and 130 nm. For electrons, an acceleration voltage of 3 kV is required to penetrate the standard aluminium reflection layer. With the use of an aluminium coating, the maximum diameter for the phosphor screen is reduced by 1 mm to allow contact between the aluminium layer and the substrate.

- **Water Glass**
  to improve the mechanic stability of a phosphor screen, water glass can be added during the sedimentation process. A screen manufactured this way can resist a light finger touch. An efficiency decrease of 30 % to 40 % results from this manufacturing process as the density of the phosphor grains in the matrix is reduced.

Warranty and Storage

The phosphor screens can withstand an electric field of up to 6000 V/mm and can be used under vacuum conditions. Due to their small thickness, the phosphor and Al-layer are very sensitive to any kind of mechanic stress. Even a light touch with a finger can damage the coating, just like their use in a vacuum chamber containing dust or particles. Therefore, we cannot extend our warranty to defects turning up during the operation of our phosphor screens. Prevent phosphor screens from light because it can lead to damages. We recommend to store phosphor screens in darkness under vacuum conditions or in dried nitrogen.

BK, 21.07.00

PROXITRONIC
Robert-Bosch-Str. 34 D-64625 Bensheim
Tel. ++49 / (0) 62 51 / 17 03-54 Fax ++49 / (0) 62 51 / 17 03-90
E-Mail bk@proxitronic.de Internet http://www.proxitronic.de