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Fukai et al.

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[45] Dec. 31, 1974

[54] PHOTOELECTRIC TRANSDUCER ELEMENT INCLUDING A HETEROJUNCTION FORMED BY A PHOTOELECTRIC TRANSDUCER FILM AND AN INTERMEDIATE FILM HAVING A LARGER ENERGY GAP THAN THE PHOTOELECTRIC TRANSDUCER FILM

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[21] Appl. No.: **304,050**

[30] **Foreign Application Priority Data**

Nov. 9, 1971	Japan	46-89622
Dec. 29, 1971	Japan	47-3265
Sept. 25, 1972	Japan	47-96428

[52] **U.S. Cl.** .... **313/94,** 252/62.3 ZT, 357/16, 357/30, 357/61

[51] **Int. Cl.** **H01j 39/06,** H01l 9/00

[58] **Field of Search** .... 313/94, 96, 65 AB; 317/235 AC, 235 NA, 235 AP, 235 AQ; 250/211 J; 338/15; 252/62.3 ZT

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Assistant Examiner—Wm. H. Punter
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[57] **ABSTRACT**

A photoelectric transducer element having high photo and spectral sensitivity in which a material with an energy band gap larger than that of a photoelectric transducer film is interposed between the photoelectric transducer film and a transparent conductive film.

11 Claims, 9 Drawing Figures

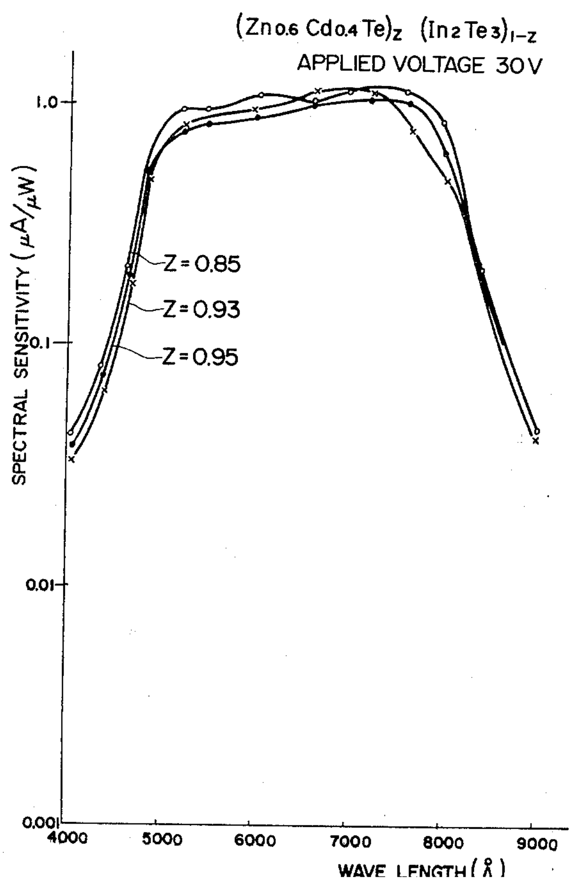


FIG. 1

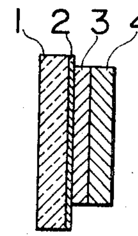


FIG. 2

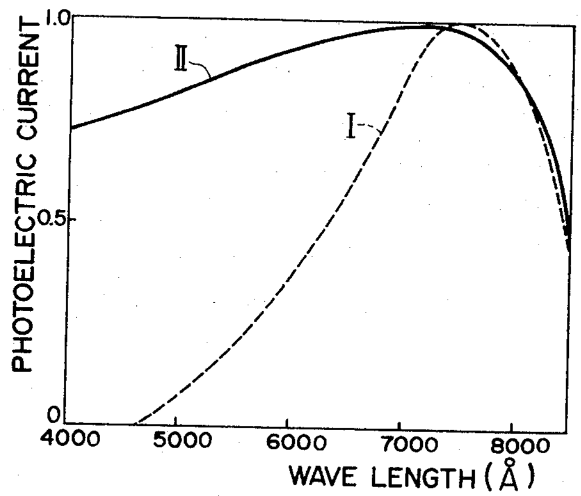


FIG. 3

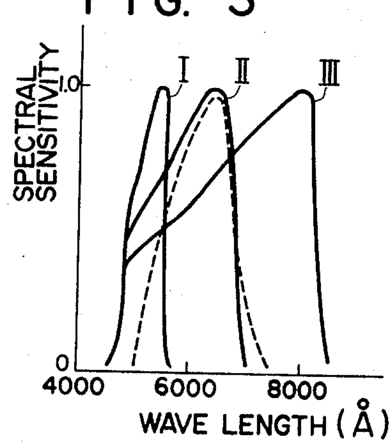


FIG. 4

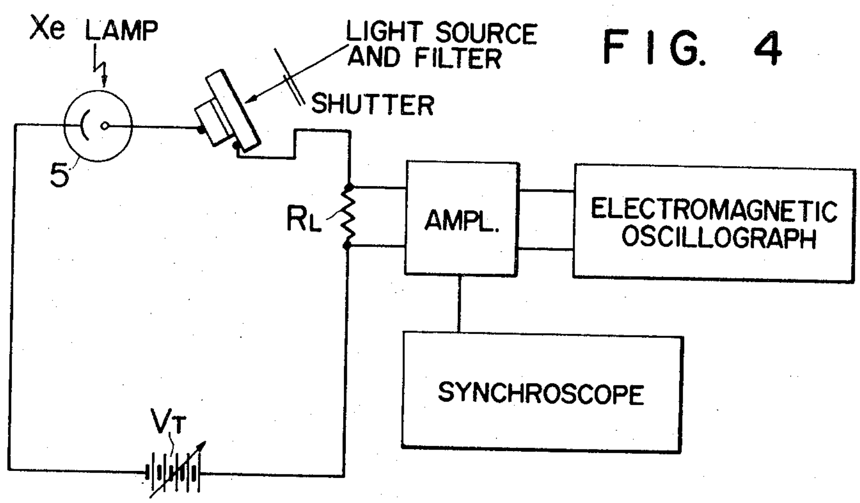


FIG. 5

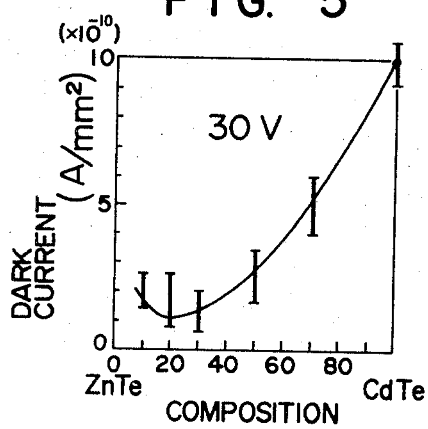


FIG. 6

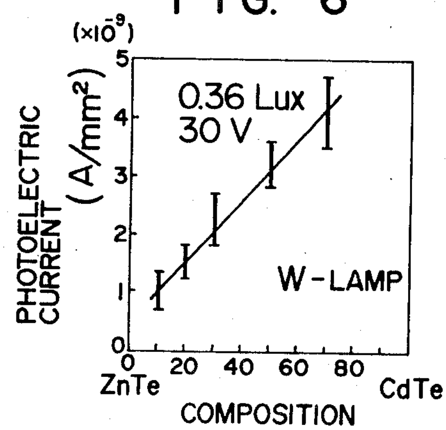


FIG. 7

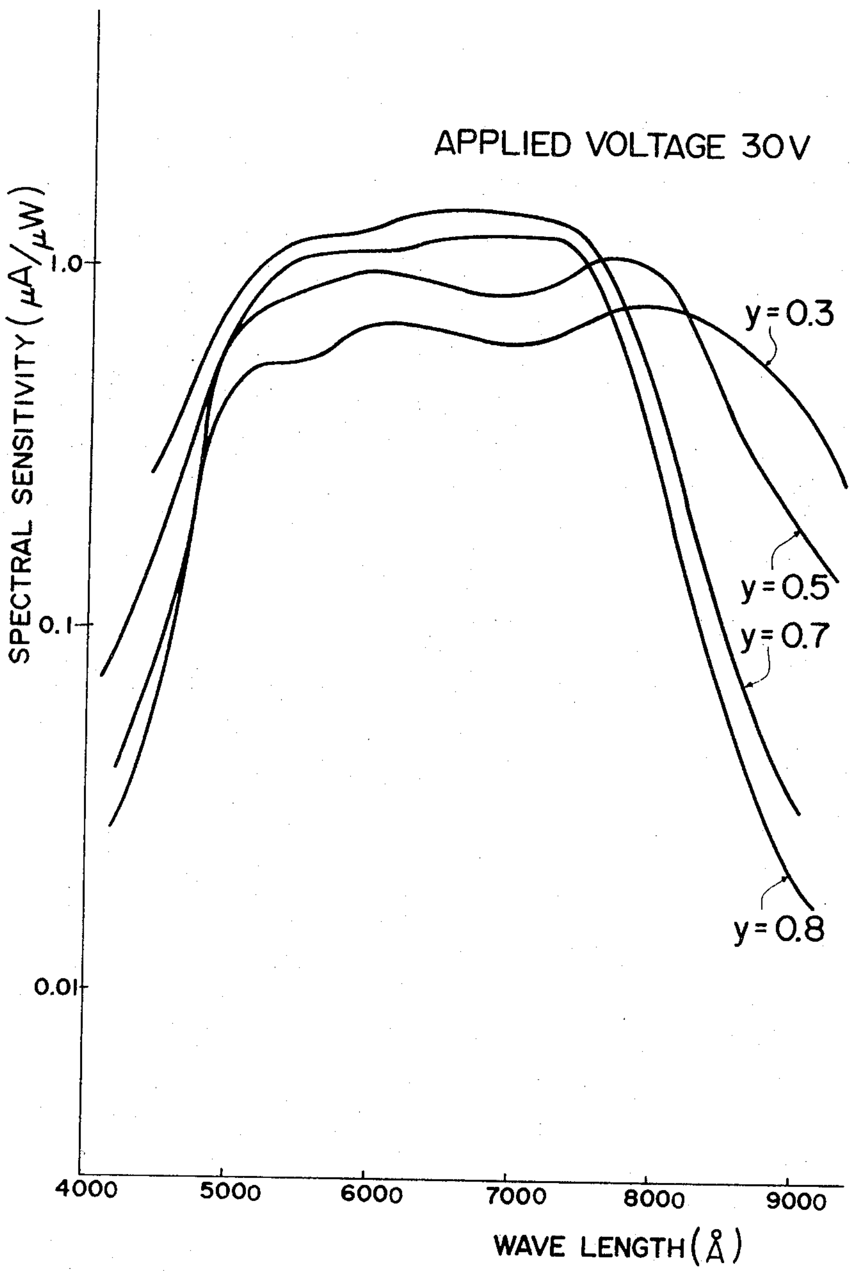

APPLIED VOLTAGE 30V
SPECTRAL SENSITIVITY (μA/μW)
1.0
0.1
0.01
y=0.3
y=0.5
y=0.7
y=0.8
4000
5000
6000
7000
8000
9000
WAVE LENGTH (Å)

FIG. 8

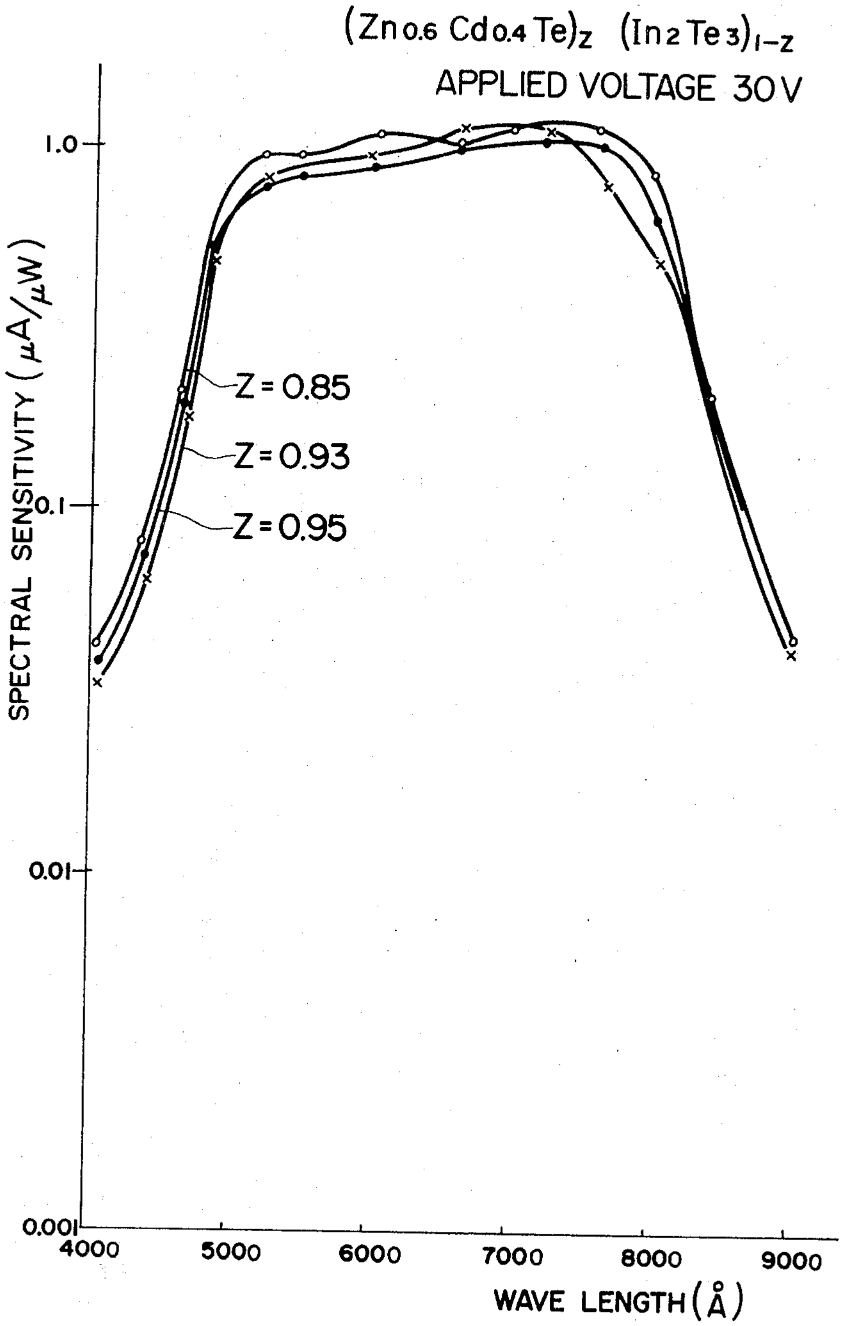
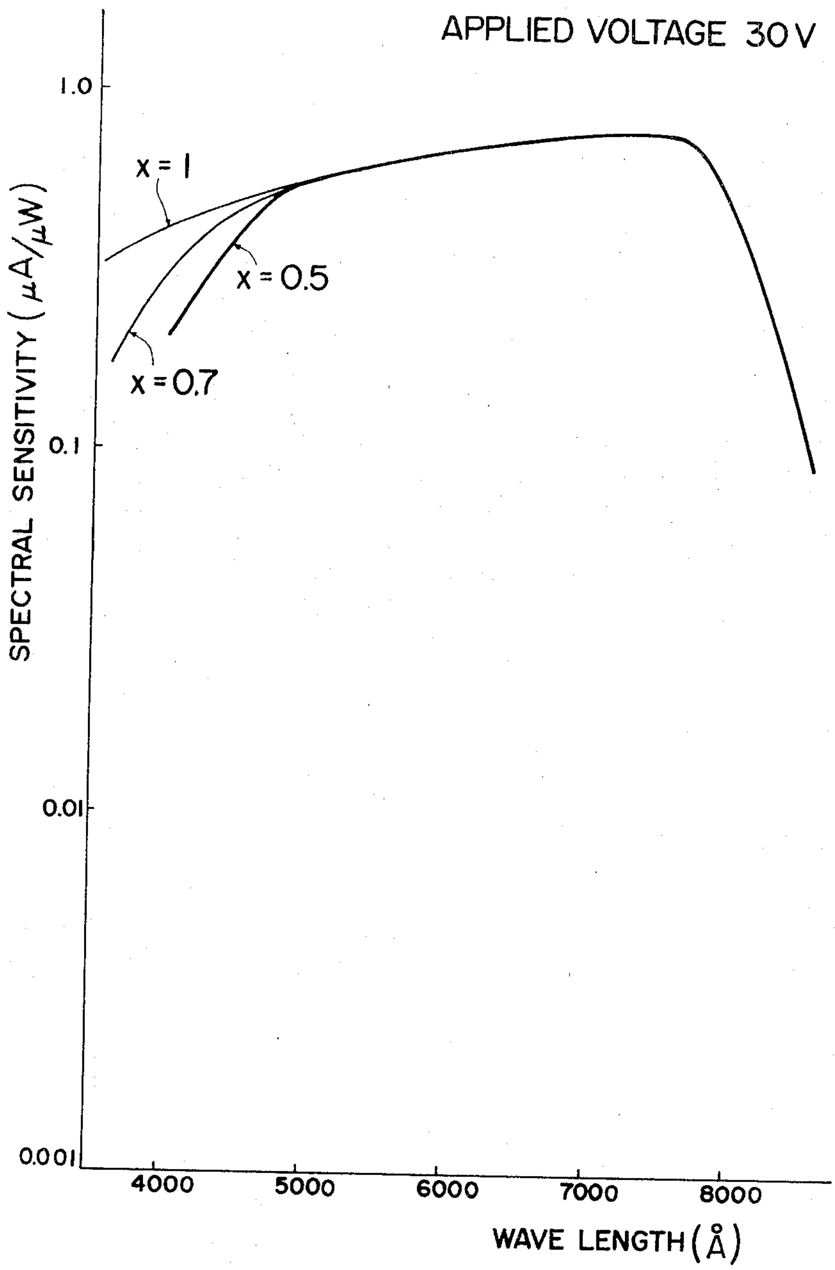

$(Zn_{0.6}Cd_{0.4}Te)_Z\ (In_2Te_3)_{1-Z}$
APPLIED VOLTAGE 30V
SPECTRAL SENSITIVITY (μA/μW)
1.0
0.1
0.01
0.001
Z = 0.85
Z = 0.93
Z = 0.95
4000
5000
6000
7000
8000
9000
WAVE LENGTH (Å)

FIG. 9


APPLIED VOLTAGE 30V
1.0
0.1
0.01
0.001
x = 1
x = 0.5
x = 0.7
SPECTRAL SENSITIVITY (μA/μW)
4000
5000
6000
7000
8000
WAVE LENGTH (Å)

PHOTOELECTRIC TRANSDUCER ELEMENT INCLUDING A HETEROJUNCTION FORMED BY A PHOTOELECTRIC TRANSDUCER FILM AND AN INTERMEDIATE FILM HAVING A LARGER ENERGY GAP THAN THE PHOTOELECTRIC TRANSDUCER FILM

The present invention relates to a photoelectric transducer element, or more in particular to a photoelectric transducer element suitably used as a target for an image pickup tube.

CdS, CdSe and mixed crystals thereof are well known as materials suitable for a photoelectric transducer element. In spite of their high sensitivity, however, they can not be used as a target of an image pickup tube due to considerable dark current accompanying them and their slow responsiveness to light. Also, their spectral sensitivity is low for wavelengths other than those corresponding to their energy band gaps, and materials with a spectral sensitivity curve which is flat over the entire range of visible light have yet to be developed.

Well-known conventional materials used as targets for image pickup tubes include a film of antimony trisulfide Sb_2S_3 for vidicons, lead oxide PbO for PbO vidicons and a silicon photodiode array for silicon vidicons. All of these materials, however, have their problem points as mentioned below.

1. Vidicons

The vidicon has the sensitivity in the order of 200 to 300 μA/lm and the dark current of 20 nA per one inch vidicon, and is used as a camera for industrial television, but its low sensitivity limits the images capable of being picked up to those of brightness in the order of 5 lx or more. Another disadvantage of the vidicon is a considerable amount of undesirable afterimage and lay-image accompanying the pickup operation, making it unsuitable for use with a color image pickup tube for television broadcasting.

2. PbO vidicon

With a very small amount of dark current of 0.2 nA/1.5 inches and a little lay-image, this is widely used with an image pickup tube for television broadcasting. But its sensitivity is as low as 300 μA/lm which is a little higher than that of the vidicon but still inadequate. Since this has no spectral sensitivity for a red light with wavelength of 650 nm or more, the use of this PbO vidicon for the red color image pickup tube of the three-tube type camera requires PbS to be added to PbO so as to increase its sensitivity to about **850** nm. The sensitivity and lag-image of this image pickup tube, however, do not coincide with those of the other tubes of the camera, resulting in the lack of balance among the three tubes. Further, it is impossible to use this image pickup tube for a single-tube camera since it has only a small range of spectral sensitivity.

3. Si vidicon

This image pickup tube has the advantages of a sensitivity 20 times that of the vidicon and the absence of undesirable after-image. But is characteristics associated with lag-images and resolution are inferior to those of the PbO vidicon, making it unsuitable for use with an image pickup tube for television broadcasting. Another disadvantage of this tube lies in that the peripheral portions of an image of a very bright object are blurred thereby to undesirably enlarge the image to a size two or three times the original image.

Accordingly, it is an object of the present invention to provide a photoelectric transducer element suitable for the target of an image pickup tube and having a high sensitivity and superior property of spectral sensitivity.

The photoelectric transducer element according to the present invention is characterized in that a material with an energy band gap larger than that of a photoelectric transducer film is interposed between a transparent conductive film and the photoelectric transducer film.

The above and other objects, features and advantages will be made apparent by the detailed description taken in conjunction with the accompanying drawings, in which:

FIG. **1** is a sectional view showing an embodiment of the present invention;

FIG. **2** is a diagram comparing the spectral sensitivity of a photoelectric transducer element with a ZnSe film interposed between the transparent conductive film and the photoelectric transducer film with that of a photoelectric transducer element without any ZnSe film interposed;

FIG. **3** is a diagram showing the spectral sensitivity of ZnSe-$Zn_yCd_{1-y}Te$;

FIG. **4** is a diagram showing the principle on which the responsiveness to light is measured;

FIG. **5** is a graph showing how the dark current varies with the composition of ZnSe-$(Zn_yCd_{1-y}Te)_{0.95}(In_2Te_3)_{0.05}$;

FIG. **6** is a diagram showing how the photoelectric current varies with the composition of the ZnSe-$(Zn_yCd_{1-y}Te)_{0.95}(In_2Te_3)_{0.05}$;

FIG. **7** is a diagram showing the spectral sensitivity of the photoelectric transducer element consisting of ZnSe-$(Zn_yCd_{1-y}Te)_{0.95}(In_2Te_3)_{0.05}$;

FIG. **8** is a characteristic diagram showing the spectral sensitivity of the photoelectric transducer element consisting of ZnSe-$(Zn_{0.6}Cd_{0.4}Te)_z(In_2Te_3)_{1-z}$; and

FIG. **9** is a characteristic diagram showing the spectral sensitivity of the photoelectric transducer element consisting of ZnS_xSe_{1-x}-$(Zn_{0.6}Cd_{0.4}Te)_{0.95}$-$(In_2Te_3)_{0.05}$.

Referring to FIG. **1**, a transparent conductive film **2** of, say, In_2O_3 or SnO_2 is formed on a glass substrate **1**, and a photoelectric transducer film **4** is formed on the transparent conductive film **2** with an intermediate film **3** therebetween having an energy band gap larger than that of the photoelectric transducer film **4.** A heterojunction is formed by the intermediate film **3** and the photoelectric transducer film **4.**

The facts that must be taken into consideration in selecting the material for the intermediate film **3** are (1) that the lattice constant, crystal structure and the coefficient of thermal expansion of the intermediate film approximate those of the photoelectric transducer film and (2) that the band structure of the intermediate film **3** and the photoelectric transducer film are capable of being connected smoothly with each other when they are bonded together. These conditions must be met to improve the photoelectric transducing efficiency by improving the crystal quality of the surface of that side of the photoelectric transducer film from which light enters and thereby reducing the surface state due to lattice defects. Light with a wavelength shorter than one corresponding to the energy band gap of the photoelectric transducer film is absorbed by the photoelectric transducer film at a portion very near its surface. If this portion has a low crystal quality with many recombination centers present in that portion, a low photoelectric transducing efficiency results.

The results of experiments conducted by the inventors show that the energy band gaps of the intermediate film **3** and the photoelectric transducer film **4** determine the limits of short and long wavelength respectively for which the spectral sensitivity is effective. FIG. **2** shows the results of the test in which the characteristic of the photoelectric transducer film **4** of $(Zn_{0.7}Cd_{0.3}Te)_{0.95}(In_2Te_3)_{0.05}$ with the intermediate film **3** of ZnSe is compared with the photoelectric transducer film of the same substance without the intermediate film **3** of ZnSe. In this figure, curve I is the case without any ZnSe film and curve II with the ZnSe film. It will be easily understood from this drawing that curve II associated with the transducer film with the ZnSe film represents a spectral sensitivity for short wavelengths much higher than curve I showing the characteristic of the transducer film in the absence of the ZnSe film. Also, it was found that the use of the ZnSe film reduces the dark current. Further, as a result of comparison, on a replica photograph taken under the electronic microscope, between a first photoelectric transducer element with the intermediate film of ZnSe laid between the glass substrate and the photoelectric transducer film of 500 A. and a second photoelectric transducer element without any intermediate film, it was made clear that the grain size of the transducer element with the ZnSe film is larger than that without any ZnSe film.

Before reference is had to embodiments of the present invention, explanation will be made below of the methods of manufacturing and measuring the characteristics of the photoelectric transducer element which were commonly applied to all of the embodiments.

First, several depositing heaters are placed in a depositing means and such a depositing material as ZnS, ZnSe, ZnTe, CdTe, In_2Te_3 or their solid solution is applied to the heaters. By controlling the temperature of the heaters, a solid solution of a desired composition is made. The availability of several heaters permits the manufacture of a composite film without affecting the vacuum condition. A glass substrate with the transparent conductive film attached thereto is heated to 100° to 400°C thereby to deposit the solid solution of the above-mentioned composition on it by evaporation. The resulting assembly is heated at 300° to 700°C for from several minutes to several hours to produce a photoelectric transducer element.

The dark current, photoelectric current, responsiveness to light and spectral sensitivity of the photoelectric transducer element thus produced and with an electrode formed on that side having the photoelectric transducer film were measured, the results of which are as follows:

a. Spectral sensitivity

An interference filter and a halogen lamp of 3400°K were used to measure the photoelectric current at regular intervals of 200 A. The amount of light applied to the specimen through the filter from a light source was measured by means of a thermopile.

b. Dark current and photoelectric current

The current-voltage characteristic as well as the photoelectric current-illumination characteristic were measured with the Electrometer Model 610C of keithley.

c. Responsiveness to light

The response to light of an image pickup tube is different from the photoconductive response of an element thereof in principle. The inventors have prepared an equivalent circuit which requires no electron beam, associated with a picture element of the image pickup tube scanned by an electron beam, thereby to evaluate the characteristics of the image pickup tube through an element. The principle of the evaluation is as shown in FIG. **4,** in which the photoelectric tube **5** is seen to be turned on and off by a light pulser with a pulse width of 2 μs at 60 Hz so as to apply an electron beam to a picture element at 60 Hz. Light of 0.4 lx was radiated on the element from another light source of the halogen lamp of 3,400°K so that the responsiveness to light was measured with a shutter usually used for photographing. The results of the measurements mentioned above coincide pretty well with those of measurements conducted on an image pickup tube assembled from the element. The measurements were made in terms of a rise and fall in % 50 ms after the application and shutting off the light respectively.

d. Composition of the deposited film

The composition of the deposited film was measured by solid mass analysis and activation analysis.

After measuring the characteristics of the element as above, the characteristics of the image pickup tube were determined as follows:

a. Dark current and photoelectric current:

A positive voltage was applied to that side of the image pickup tube to which the transparent conductive film is attached, during the scanning by an electron beam, and a signal current taken out of the transparent conductive film was measured.

b. Lag-image and after-image:

A lag-image is a transient phenomenon representing the magnitude of a signal current remaining 50 ms after shutting light off. It occurs during the transition stage from a bright to dark state and is generally expressed in the percentage of a signal remaining at a time point 50 ms after shutting light off. An afterimage is a term indicating a time period, as observed by a display monitor, needed for an image of an object to be extinguished on a uniformly white background which was picked up after picking up the object for a predetermined period of time under a standard pickup condition.

Embodiments of the present invention will be now explained.

Embodiment 1:

A photoelectric transducer element was used which comprises a heterojunction of an intermediate film of ZnS_xSe_{1-x} and a photoelectric transducer film of $Zn_yCd_{1-y}Te$ and experiments were conducted by varying the value y of $Zn_yCd_{1-y}Te$ while maintaining x of ZnS_xSe_{1-x} at zero.

As shown in FIG. **1,** the assembly comprising a glass substrate **1** with a transparent conductive film **2** deposited on it was heated to and maintained at the temperature of 150° to 400°C, and ZnSe, that is ZnS_xSe_{1-x} with x at zero, is deposited by evaporation into the thickness of 0.02 to 2 microns on the transparent conductive film **2** for 5 to 30 minutes. On this ZnSe film **3** is formed a solid solution **1** to 20 × 10^{-6} m thick by evaporation in a pair of melting pots containing ZnTe and CdTe respectively, while maintaining the temperature of the substrate at 150° to 300°C for 5 to 60 minutes. The value of y of the solid solution may be varied by controlling the temperature of the melting pots. A composite film thus obtained is heated at the temperatures from 300° to 700°C thereby to produce a photoelectric transducer element.

The spectral sensitivities of the photoelectric transducer element with the value of y at 1, 0.8 and 0 in $Zn_yCd_{1-y}Te$ are as shown respectively by curves I, II and III of FIG. 3, the dashed line in the figure showing the spectral sensitivity of an Sb_2S_3 film.

As can be seen from this figure, the effect of spectral sensitivity extends further toward long wavelengths, the greater the amount of Cd relative to that of Zn. This is because the band gap is decreased with an increase in the amount of Cd. As a result, it is possible, by appropriately selecting the value of y, to obtain a photoelectric transducer element with a spectral sensitivity over the entire range of visible light.

The characteristics of a one-inch image pickup tube employing the photoelectric transducer element according to the present invention are compared with those of the conventional Sb_2S_3 vidicon in Table 1 below.

TABLE 1

	Present invention			Conventional vidicon
	y=1.0	y=0.8	y=0	
sensitivity (μA/lm)	250	380	660	200
dark current (nA)	8	18	25	20
residual images	30	29	19	30

It will be noted from this table that the sensitivity of the image pickup tube according to the present invention is 2 or 3 times higher than that of the conventional vidicon. Further, with the increase in the amount of Cd, the sensitivity is improved but the dark current is also increased. There are less lagimage with the increase in the amount of Cd. All this tells that the photoelectric transducer element according to the present invention has a higher sensitivity and a broader range of spectral sensitivity than the Sb_2S_3 vidicon.

Furthermore, it was found that not only the spectral sensitivity for short wavelength is improved but the range of spectral sensitivity broadened and the sensitivity itself improved by replacing the intermediate film of ZnSe by a film of ZnS or the solid solution consisting of ZnS and ZnSe.

Embodiment 2

This embodiment has the same structure as embodiment 1, employing an intermediate film of ZnS_xSe_{1-x} as in embodiment 1 while it is different from embodiment 1 in that $Zn_yCd_{1-y}Te$ with In added thereto is used as a photoelectric transducer film. When the amount of In added to the photoelectric transducer film of $Zn_{0.8}Cd_{0.2}Te$ was changed from 1×10^{17}/cc to 2×10^{21}/cc, in the presence of an intermediate film of ZnSe, dark current which occurred in the photoelectric transducer element is as shown in Table 2 below.

TABLE 2

Amount of In added	dark current (A/mm²) at 10 V
undoped	about 10^{-8} A/mm²
2×10^{18}/cc	about 10^{-9} A/mm²
2×10^{19}/cc	about 10^{-9} A/mm²
2×10^{20}/cc	about 10^{-9} A/mm² to 10^{-10} A/mm²
2×10^{21}/cc	about 10^{-10} A/mm²

From this experiment, it is known that the dark current tends to decrease with the increase in the amount of indium added to the photoelectric transducer film.

It was found that, if the solid solution of $Zn_{0.8}Cd_{0.2}Te$ remains unchanged, the spectral sensitivity also remains almost the same, but when the amount of indium added is higher than 10^{20}/cc, the sensitivity curve extends toward long wavelength. The absolute value of the sensitivity has sharply increased with the increase in the amount of In added. The representative characteristics of a one-inch image pickup tube with a target employing an element of the above-mentioned materials are shown in Table 3.

TABLE 3

	sensitivity (μA/lm)	dark current at 10 volt (nA)	after-images (%)
undoped	380	18	29
2×10^{18}/cc	550	17	35
2×10^{20}/cc	1340	12	25
2×10^{21}/cc	3000	8	29

As will be apparent from this table, the sensitivity rises considerably with the increase in the amount of indium added, while dark current decreases, with the result that the S/N ratio for the photoelectric transducer film obtained by adding indium in the amount of 2×10^{21}/cc in an evaporation source is improved by more than one order. Lag-images have remained almost the same.

As in embodiment 1, the spectral sensitivity for short wavelength can be improved and the range of wavelength over which the sensitivity is effective can be broadened by replacing the intermediate film of ZnSe with a solid solution of ZnS_xSe_{1-x}. As to the long wavelength side, the sensitivity may be extended to a desired wavelength by changing the ratio between Zn and Cd of the photoconductive film.

In the above-described experiment, the deposited film was made in the same way as in embodiment 1 by adding indium to the $Zn_{0.8}Cd_{0.2}Te$ through thermal diffusion and the amount of indium is shown in terms of the quantity placed in an evaporation source. The results of mass analysis show, however, that where a solid solution of $Zn_{0.8}Cd_{0.2}Te$ containing indium in the amount of 2×10^{21}/cc is used as an evaporation source, 3.2 atomic percent of indium is contained in the deposited film. On the other hand, where a solid solution containing 2×10^{18}/cc of indium is used, the deposited film contains 0.02 atomic percent of indium.

Embodiment 3

ZnS_xSe_{1-x} and $(Zn_yCd_{1-y}Te)_z(In_2Te_3)_{1-z}$ were used for the intermediate film and the photoelectric transducer film respectively as in embodiment 1. Experiments were conducted by varying the value of x, y and z separately. Since the structure and the method of manufacture of the photoelectric transducer element are the same as in embodiment 1, only the results of the experiment and advantages of the present embodiment will be mentioned below.

1. $ZnSe\text{-}(Zn_yCd_{1-y}Te)_{0.95}(In_2Te_3)_{0.05}$

First, reference is made to a photoelectric transducer element with the intermediate film of ZnSe and a photoelectric transducer film of a varying ratio between Zn and Cd. With 5 percent of In_2Te_3 added, experiments were conducted on the six values of y, i.e. 0.9, 0.8, 0.75, 0.7, 0.5 and 0.3, the results of which are shown below.

a. Dark current

How dark current depends on the value of y is shown in FIG. **5.** It is seen that the dark current becomes minimum when y is 0.7 to 0.8 and it sharply increases at a value of y lower than 0.7 or 0.8.

b. Sensitivity

The value y affects the sensitivity in such a manner as shown in FIG. **6.** Although it must be admitted that different sensitivities result from different methods of manufacturing the element, it is apparent that the sensitivity rises with the decrease in the value of y.

c. Spectral sensitivity

Spectral sensitivity relative to the wavelength is shown in FIG. **7.** This drawing indicates that the decrease in the value y results in increased spectral sensitivity for the areas of long wavelength, whereas the spectral sensitivity curve is almost flat over the entire range of visible light.

d. Responsiveness

The results of measurement of responsiveness with the target voltage varied under the light of 0.4 lx are shown in Table 4 below.

Table 4

An example of responsiveness

Comp.	Volts 10	20	30	40	
y=0.9		67/26	78/22	80/16	
y=0.8	89/25	78/18	80/17	82/15	rise(%)/fall(%)
y=0.7		86/17	81/13	85/11	under 0.4 lx
y=0.5		89/11	92/10		after 50 msec.
y=0.3	100/13	89/12			

These figures show relatively quick response. It is also clear that the responsiveness is improved with the increase in target voltage and with the decrease in the value y.

Thus it is possible to make a desired image pickup tube by varying the composition or value of y. Table 5 below shows the characteristics of two representative image pickup tubes balanced in all the factors including sensitivity, dark current and lag-images in the range of $0.5 < y < 0.8$.

Table 5

	y=0.6	y=0.7
sensitivity (μA/lm)	4000	3840
dark current (nA)	5	4
lag-images (%)	12	14
residual images	nil	nil
after-images	nil	nil

Table 5-Continued

	y=0.6	y=0.7
resolution	780	780
illumination ($I=E^r$)	$r=0.95$	$r=0.95$

2. $ZnSe-(Zn_{0.6}Cd_{0.4}Te)_z(In_2Te_3)_{1-z}$

Experiments were made varying the amount of In_2Te_3. Evaporation sources with 0.95, 0.93, 0.85, 0.7 and 0.5 in z respectively were prepared and a target with the above-mentioned structure was produced. The results of the experiments are shown in Table 6 below.

Table 6

(response : rise(%)/fall(%) after 50 msec.)

	z = 0.95	z = 0.93	z = 0.85	z = 0.7
sensitivity (0.36 lx)	2.1×10^{-9} A/mm²	2.2×10^{-9}	2.5×10^{-9}	—
dark current (A/mm²) at 30V	2×10^{-10}	2×10^{-10}	5×10^{-10}	$>10^{-9}$
response at 20V	83/14	79/15	87/13	—
response at 30V	87/11	81/13	89/10	—
response at 40V	88/10	86/13	—	—

The dark current tends to rise when z is smaller than 0.85, while it remains almost the same when z is between 1 and 0.85. The sensitivity remains almost unchanged when z is between 1 and 0.85. The response is quick for all of the values of Z and it is quicker the higher the applied voltage. When z is smaller than 0.7, a phase of In_2Te_3 was detected in the deposited film as a result of X-ray analysis. The presence of the phase causes a great dark current, thereby making the element unsuitable for a target of the image pickup tube. Namely, 0–30 mol percent of In_2Te_3 is suitable for the target of the image pickup tube. The sensitivity remains almost unchanged when Z is between 1 and 0.85 as shown in FIG. **8.**

3. $ZnS_xSe_{1-x}-(Zn_{0.6}Cd_{0.4}Te)_{0.95}(In_2Te_3)_{0.05}$

Experiments were conducted for various values of x in ZnS_xSe_{1-x}. For all values of x including 0.5, 0.7 and 1.0 dark current, sensitivity and responsiveness all remained almost the same as in the preceding embodiment, while the spectral sensitivity for short wavelength is increased with the value of x as shown in FIG. **9.** The element with x of unity is suitable for an ultra-violet ray camera as it has a sufficiently high sensitivity for the ultra-violet range.

It will be understood from above that the above-mentioned image pickup tubes embodying the present invention have a higher sensitivity than the conventional vidicon and PbO vidicon, and the target included in the embodiments has an almost flat curve of spectral sensitivity over the entire range of visible light, making it possible to apply the present invention to a singletube color image pickup tube.

Since the photoelectric transducer element according to the present invention is high both in photosensitivity and spectral sensitivity, it can be used not only as a target of the image pickup tube but as a photoelectric transducer film for electronic photograph and illumination photometer.

The reason why the present invention is characterized by a high photosensitivity and spectral sensitivity is the interposition between the transparent conductive film and the photoelectric transducer film of an intermediate film with a larger energy band gap than the photoelectric transducer film, which not only permits the portion sensitive to light, that is, the crystal structure at the junction between the photoelectric transducer film and the intermediate film to be improved but also allows light with a longer wavelength than the one corresponding to the energy band gap of the intermediate film to enter the photoelectric transducer film without loss.

As is apparent from the above explanation of the embodiments, the photoelectric transducer element according to the present invention has a higher photosensitivity as well as higher spectral sensitivity without any lag-images, residual images or undesirable after-image.

What is claimed is:

1. A photoelectric transducer element and a target for an image pickup tube using said element, comprising a photoelectric transducer film, a transparent conductive film, a material interposed between said photoelectric transducer film and said transparent conductive film, and a heterojunction of said photoelectric transducer film and said material, said material having a larger energy gap than said photoelectric transducer film, said photoelectric transducer film containing $Zn_yCd_{1-y}Te$ $(0.1 \leqq y \leqq 0.9)$ as a main component, and said material containing ZnS_xSe_{1-x} $(0 \leqq x \leqq 1)$ as a main component.

2. A photoelectric transducer element and a target for an image pickup tube using said element according to claim **1**, wherein said photoelectric transducer film containing $Zn_yCd_{1-y}Te$—$(0.1 \leqq y \leqq 0.9)$ as the main component further contains indium added thereto.

3. A photoelectric transducer element and a target for an image pickup tube using said element according to claim **2**, wherein said photoelectric transducer film containing $Zn_yCd_{1-y}Te$ $(0.1 \leqq y \leqq 0.9)$ as the main component contains 0.02 to 3.2 atomic percent of indium added thereto.

4. A photoelectric transducer element and a target for an image pickup tube using said element according to claim **1**, wherein said photoelectric transducer film containing $Zn_yCd_{1-y}Te$-$(0.1 \leqq y \leqq 0.9)$ as the main component further contains 30 mol% or less of a compound of In and Te added thereto.

5. A photoelectric transducer element and a target for an image pickup tube using said element, comprising a photoelectric transducer film, a transparent conductive film, a material interposed between said photoelectric transducer film and said transparent conductive film, and a heterojunction of said photoelectric transducer film and said material, said material having a larger energy gap than said photoelectric transducer film, said photoelectric transducer film containing $Zn_yCd_{1-y}Te$ $(0 \leqq y \leqq 1)$ as a main component and further containing **30** mol percent or less of a compound of In and Te added thereto, said photoelectric transducer film having the formula

$$\{Zn_yCd_{1-y}Te \quad (0 \leqq y \leqq 1)\}_z\{In_2Te_3\}_{1-z} \quad (0.7 < z < 1),$$

and said material containing $ZnS_xSe_{1-x}(0 \leqq x \leqq 1)$ as a main component.

6. A photoelectric transducer element and a target for an image pickup tube using said element according to claim **5**, wherein $x = 0$ and $z = 0.95$.

7. A photoelectric transducer element and a target for an image pickup tube using said element, comprising a photoelectric transducer film, a transparent conductive film, a material interposed between said photoelectric transducer film and said transparent conductive film, and a heterojunction of said photoelectric transducer film and said material, said material having a larger energy gap than said photoelectric transducer film, said photoelectric transducer film containing $Zn_yCd_{1-y}Te$ $(0.5 \leqq y \leqq 0.8)$ as a main component and further containing 30 mol percent or less of a compound of In and Te added thereto, said photoelectric transducer film hhaving the formula

$$\{Zn_yCd_{1-y}Te\ (0.5 \leqq y \leqq 0.8)\}_{0.95}\{In_2Te_3\}_{0.05},$$

and said material containing ZnSe as a main component.

8. A photoelectric transducer element and a target for an image pickup tube using said element according to claim **5**, wherein $x = 0$ and $y = 0.6$.

9. A photoelectric transducer element and a target for an image pickup tube using said element, comprising a photoelectric transducer film, a transparent conductive film, a material interposed between said photoelectric transducer film and said transparent conductive film, and a heterojunction of said photoelectric transducer film and said material, said material having a larger energy gap than said photoelectric transducer film, said photoelectric transducer film containing $Zn_{0.6}Cd_{0.4}Te$ as a main component and further containing 30 mol percent or less of a compound of In and Te added thereto, said photoelectric transducer film having the formula

$$\{Zn_{0.6}Cd_{0.4}Te\}_z\{In_2Te_3\}_{1-z}\ (0.85 \leqq z < 1,$$

and said material containing ZnSe as a main component.

10. A photoelectric transducer element and a target for an image pickup tube using said element according to claim **5**, wherein $y = 0.6$ and $z = 0.95$.

11. A photoelectric transducer element and a target for an image pickup tube using said element according to claim **10**, wherein $x = 1$.

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