A CCD Imager Using ZnSe-Zn\textsubscript{1-x}Cd\textsubscript{x}Te Heterojunction Photoconductor

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A new CCD imager using a ZnSe-Zn\textsubscript{1-x}Cd\textsubscript{x}Te heterojunction photoconductor will be described. High sensitivity and remarkable blooming suppression are simultaneously obtained by this device with its small size picture element.

Cross sectional view of a unit cell which consist of a thin film photoconductor, a read-gate and a storage site of a vertical CCD register is schematically shown in Figure 1. The heterojunction thin film which is composed of ZnSe and Zn\textsubscript{1-x}Cd\textsubscript{x}Te multilayer are vacuum-deposited on the CCD scanning circuit. The transparent electrode of ITO film is deposited on the Zn\textsubscript{1-x}Cd\textsubscript{x}Te layer for the reverse biasing electrode of the heterojunction diode. The metal electrode for the ZnSe layer make contact with N\textsuperscript{+}diffused source area of the read-gate to read the photogenerated charge from the reverse-biased heterojunction diode into the storage site of the vertical CCD register.

The potential diagrams of the N\textsuperscript{+}source area and the CCD well at the charge-integration period and the charge-reading period are shown in Figure 2(a) and Figure 2(b), respectively. The basic idea of the device operation is that the sequential switching of the operation mode integration/reading is controlled by the pulse which is applied to the ITO terminal of the reverse-biased heterojunction diode. During the charge-integration period, ITO terminal is held at the positive high level \( \varphi_{\text{TH}} \). As a result, the potential for the electron of the N\textsuperscript{+}source area is lowered to the level which illustrated dark level in Figure 2(a). The photogenerated charge are collected in the heterojunction diode. After the integration period, the ITO terminal is held at low level \( \varphi_{\text{TL}} \) and CCD gate is pulsed high level \( \varphi_{\text{V}} \) simultaneously, then the collected charge are transferred from heterojunction diode into the storage site of the vertical CCD. If we choose the ITO terminal potential \( \varphi_{\text{TH}} \) is usually below the read-gate potential barrier \( \varphi_{\text{R}} \), the ITO terminal acts as an over flow drain for the excess charge under the intense light illumination.

The experimental device includes 404

Fig. 1 Cross sectional view of a unit cell.
of vertical BCCD shift registers interdigitated in a $404^H \times 506^V$ thin film photoconductor array and 404 bit of horizontal BCCD having a floating diffusion charge detector. The size of imaging area is 6.75 mm x 9.0 mm. The cell size of a picture element is $14 \mu m \times 24 \mu m$. The size of a metal electrode for photoconductor is $10 \mu m \times 20 \mu m$. In this case the optical aperture occupies the area of 60% of the cell.

The device was fabricated on 5Ω-cm P type Si substrate through N channel CCD process and the vacuum deposition process for the heterojunction photoconductor.

The electrical and optical characteristics obtained by the experimental device are as follows; Horizontal and vertical resolution values are 280 TV lines and 400 TV lines, respectively. The saturation signal current is 520 nA. The sensitivity is $0.16 \mu A/\ell x (2856^\circ K)$. Dark current is $1 nA/cm^2$ for the photosensor ($27^\circ c$). The signal to noise ratio is above 60 dB.

The successful blooming suppression is achieved with this structure mentioned above. The experimental result obtained by the device, with its gap of the metal electrode of heterojunction diode is covered from an incident light by the screen grid, is that the high light exposure is allowable up to $10^3$ times as intense as the saturation exposure.

Fig. 2 The potential diagram