

# エレクトロニクス

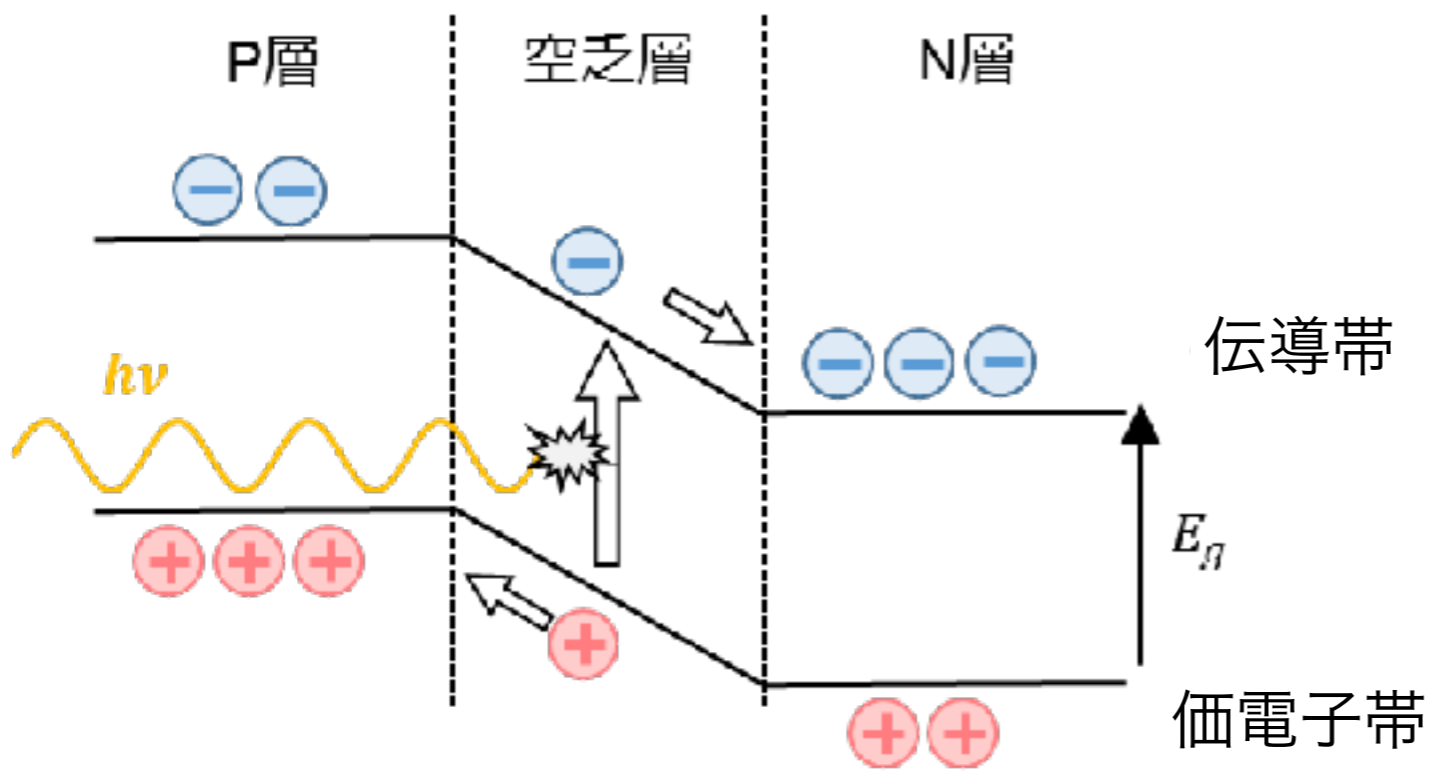
## 講義資料

### 第10章：光検出器

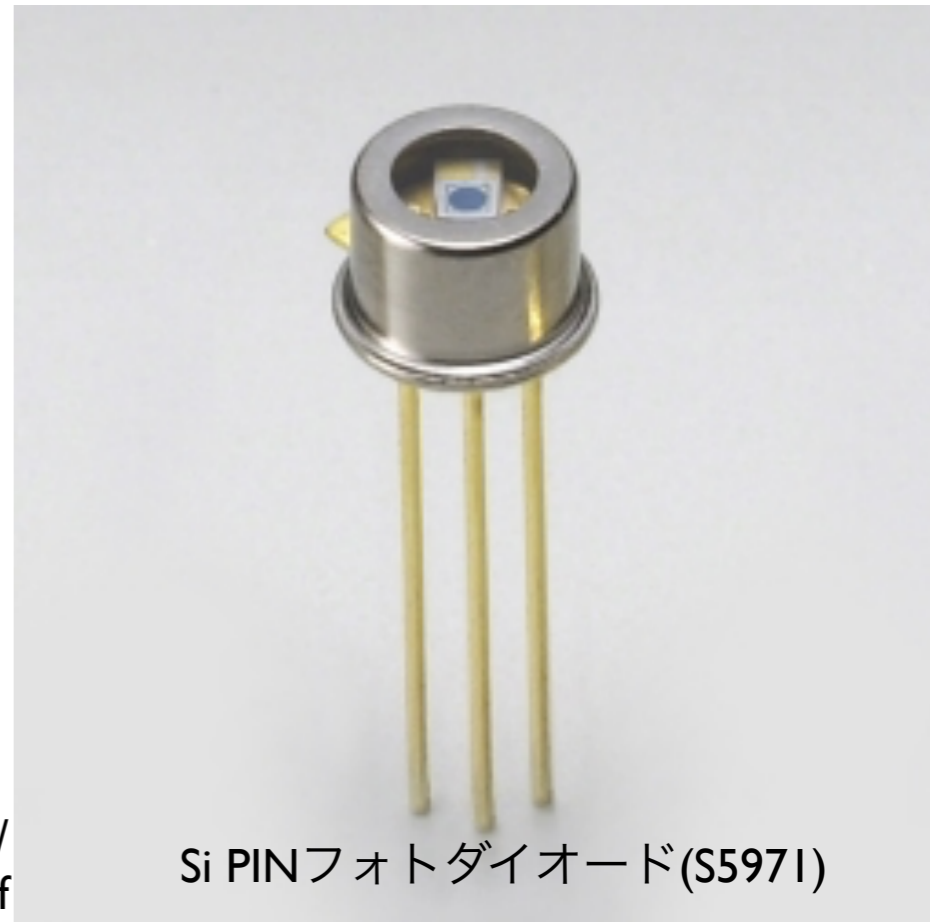
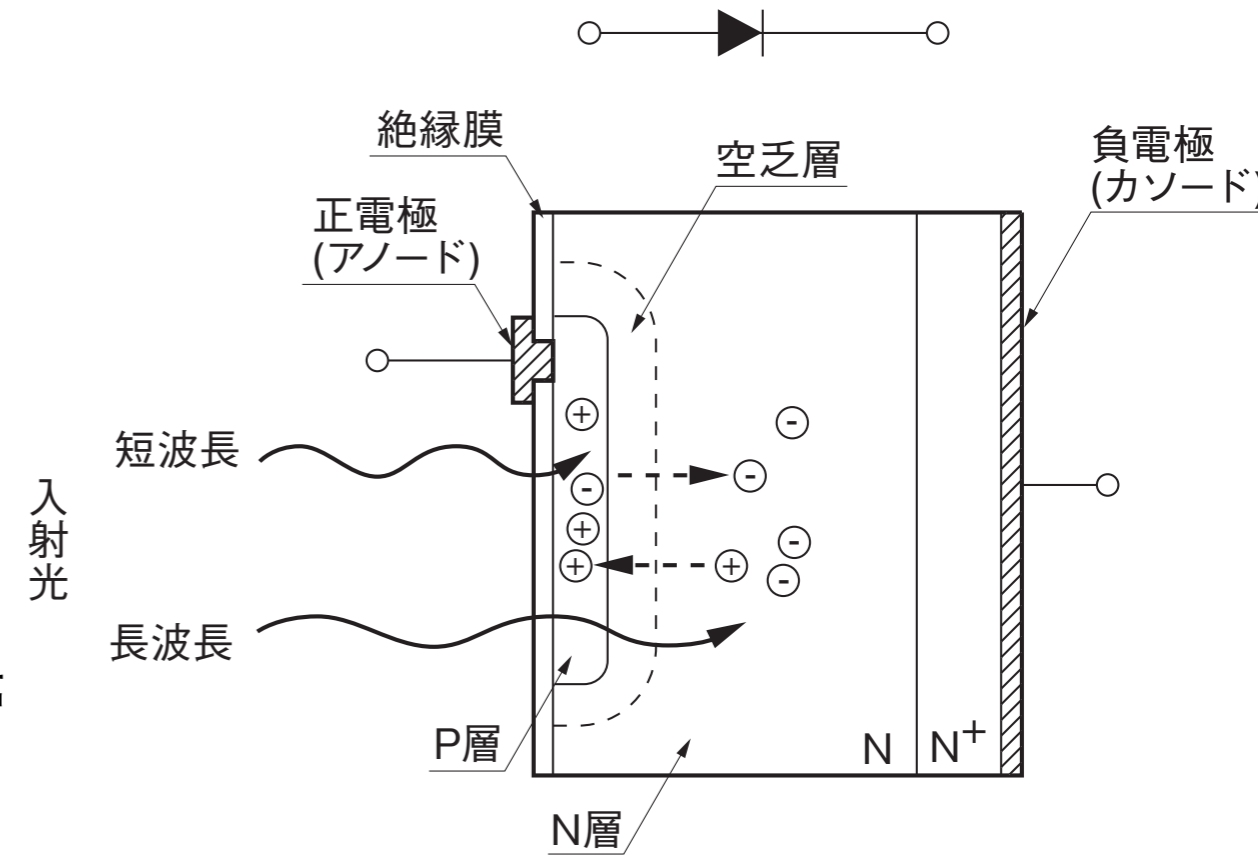
ver. 2

鶴 剛 (tsuru@cr.scphys.kyoto-u.ac.jp)

# フォトダイオード

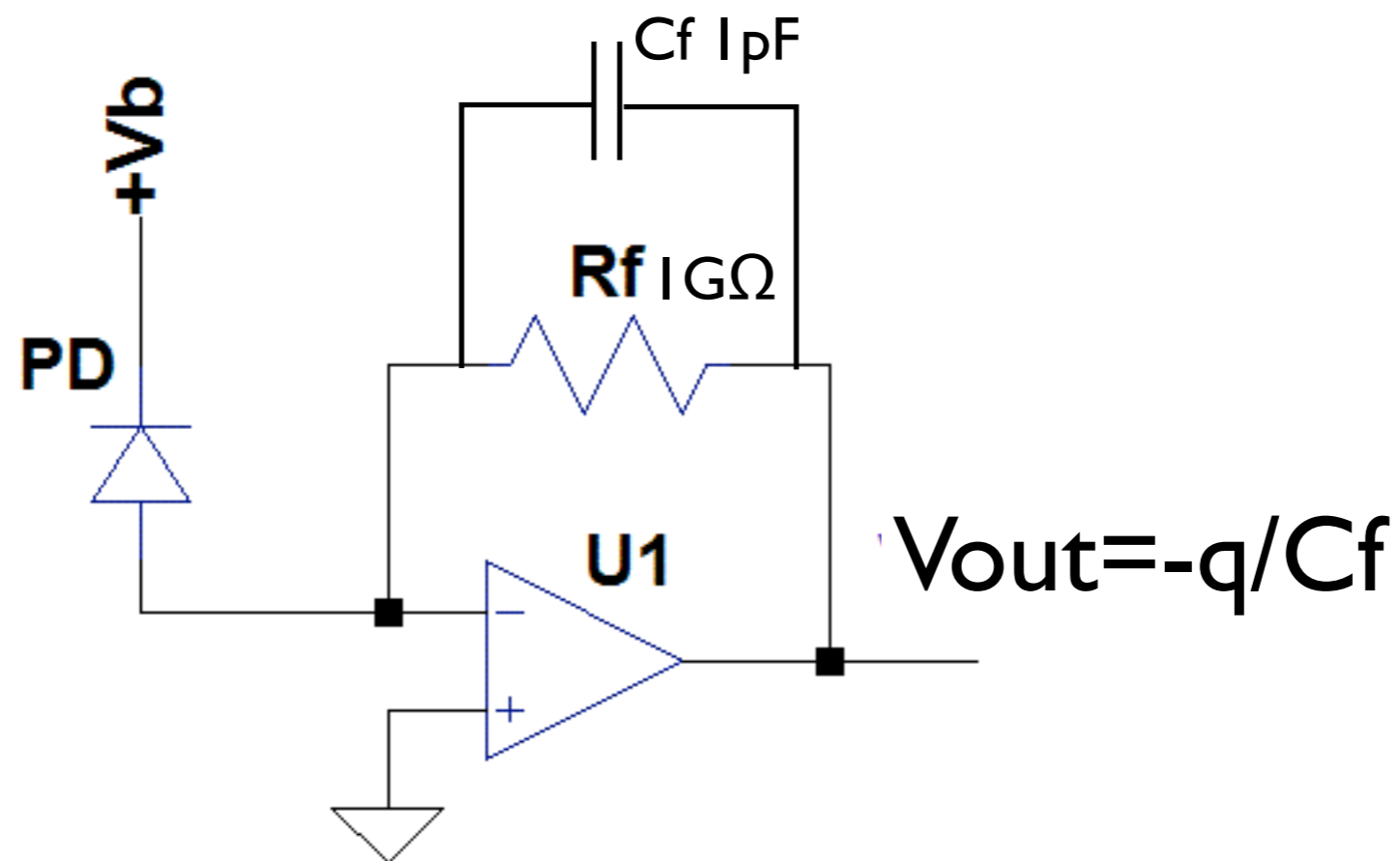
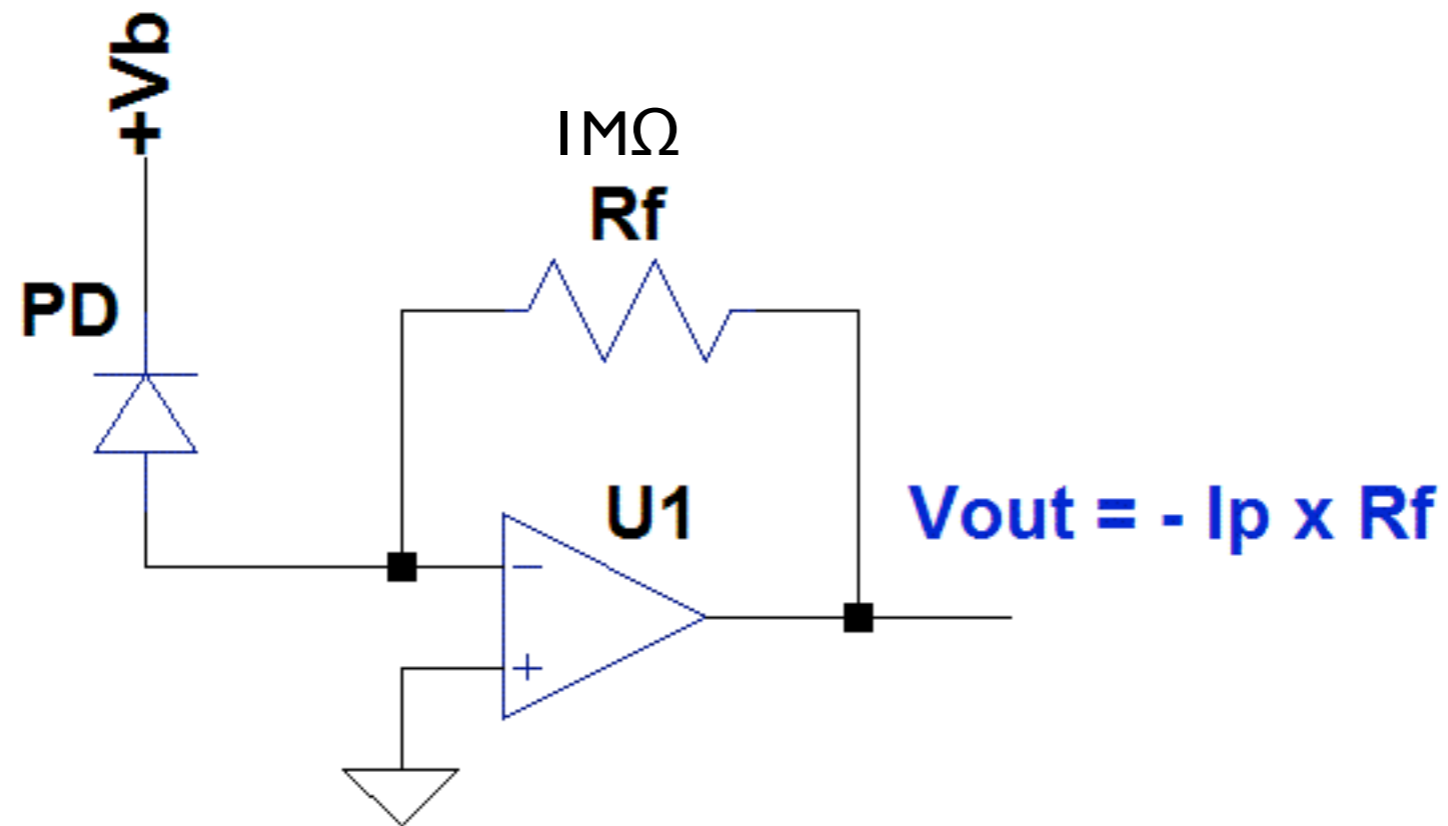


$E_g$ : バンドギャップエネルギー  
 $h\nu$ : 光のエネルギー (光子)



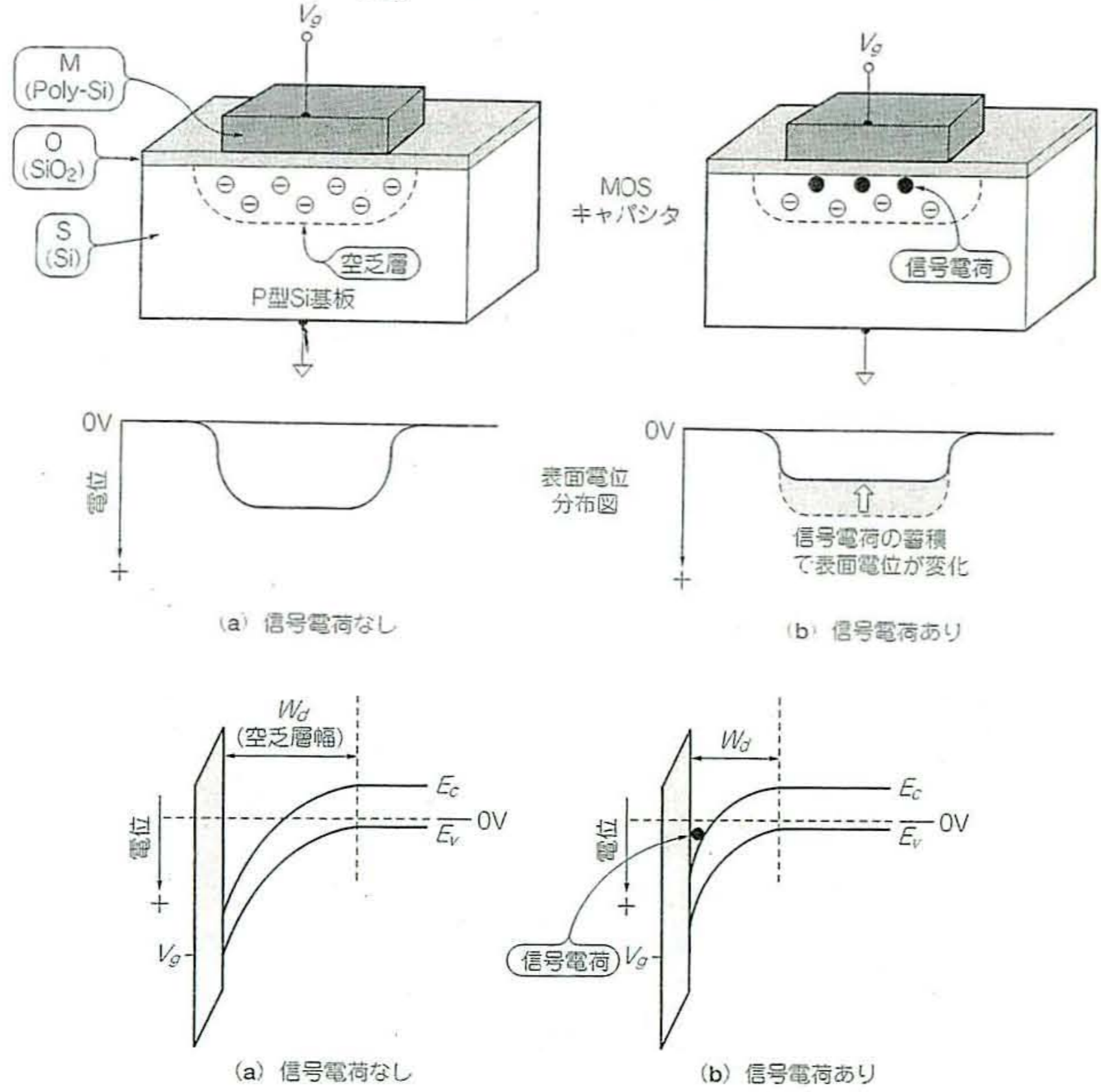
Si PINフォトダイオード(S5971)

# フォトダイオード

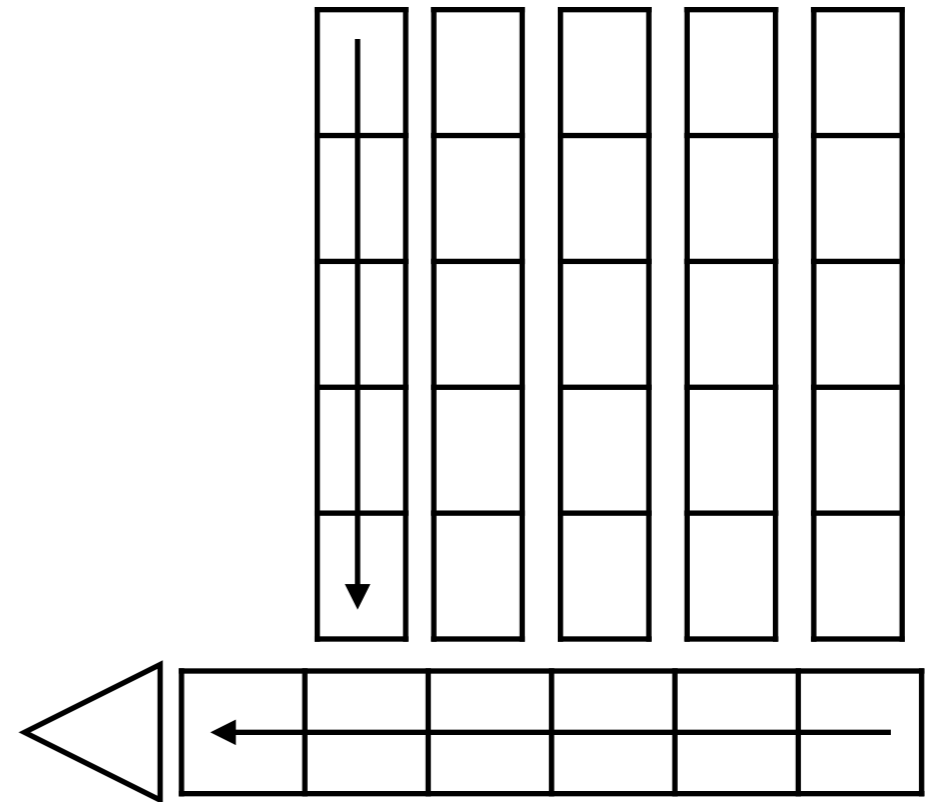
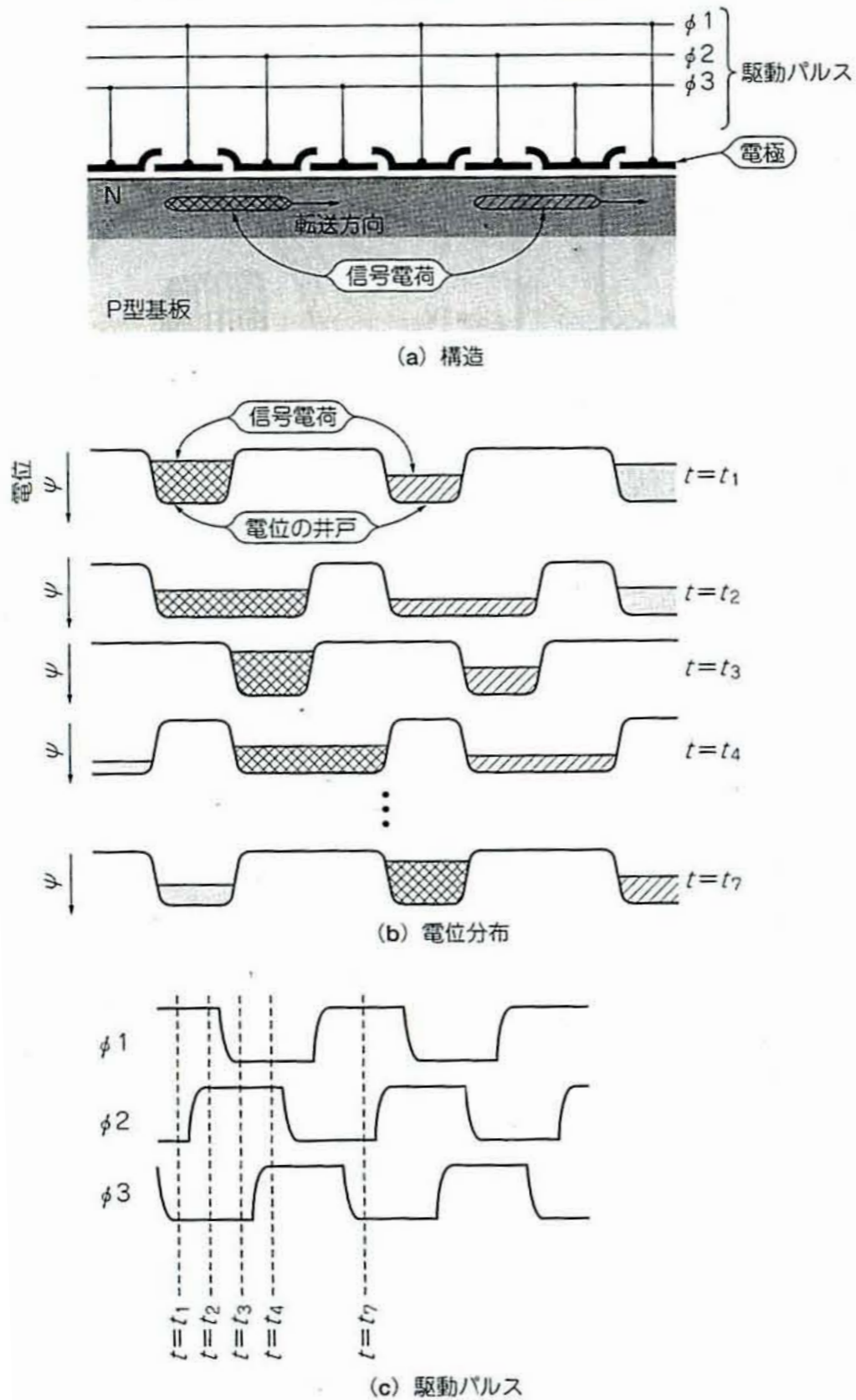


# MOSキャパシタ

〈図3-6〉 MOSキャパシタと表面電位



〈図3-15〉 3相CCDの構造、電位分布と駆動タイミング



CCD Imager  
(Full Frame Transfer Type)

# CCD

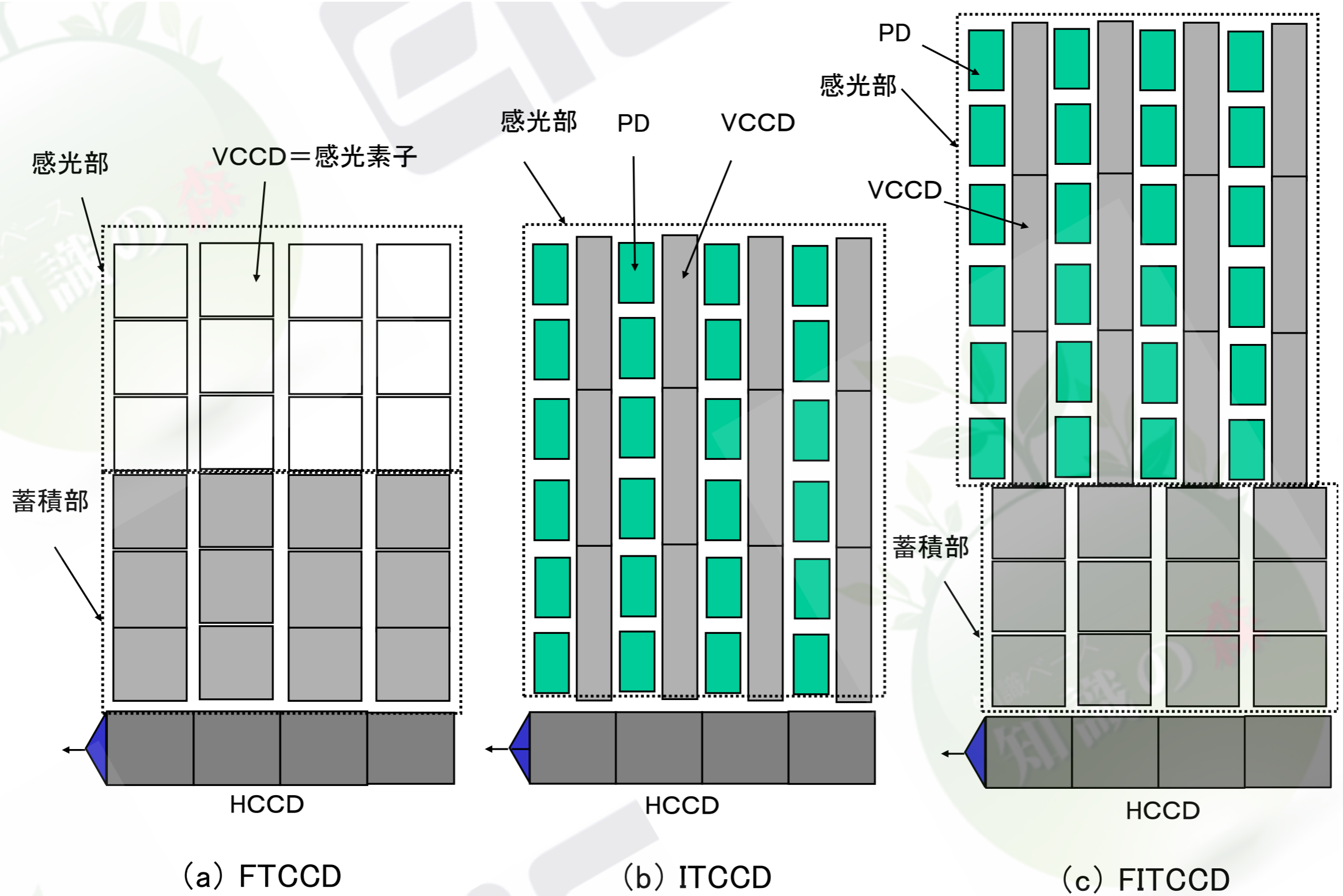


図 1・31 CCD イメージセンサの代表的構成



# CCD

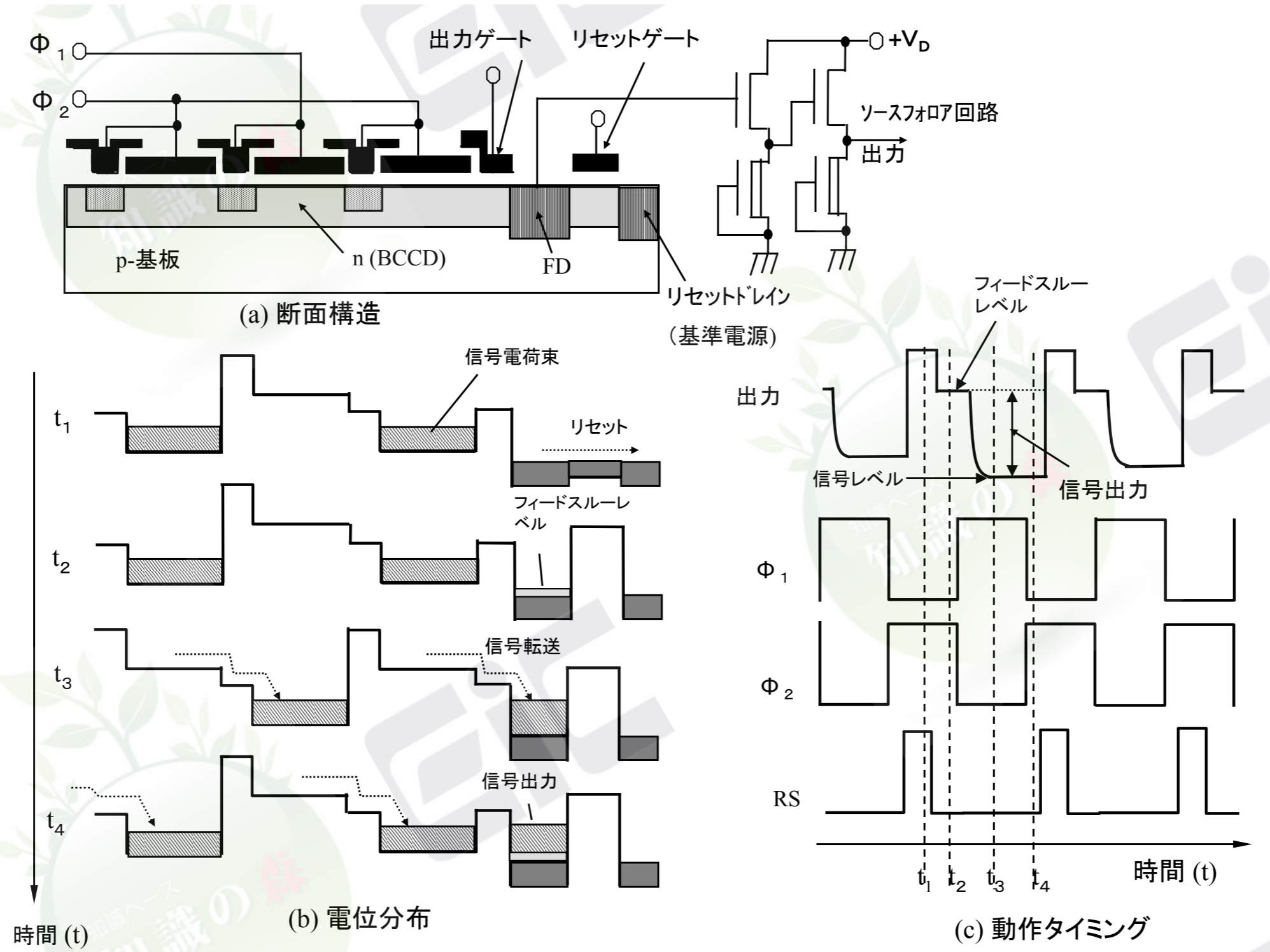


図 1・29 電荷検出動作シーケンス

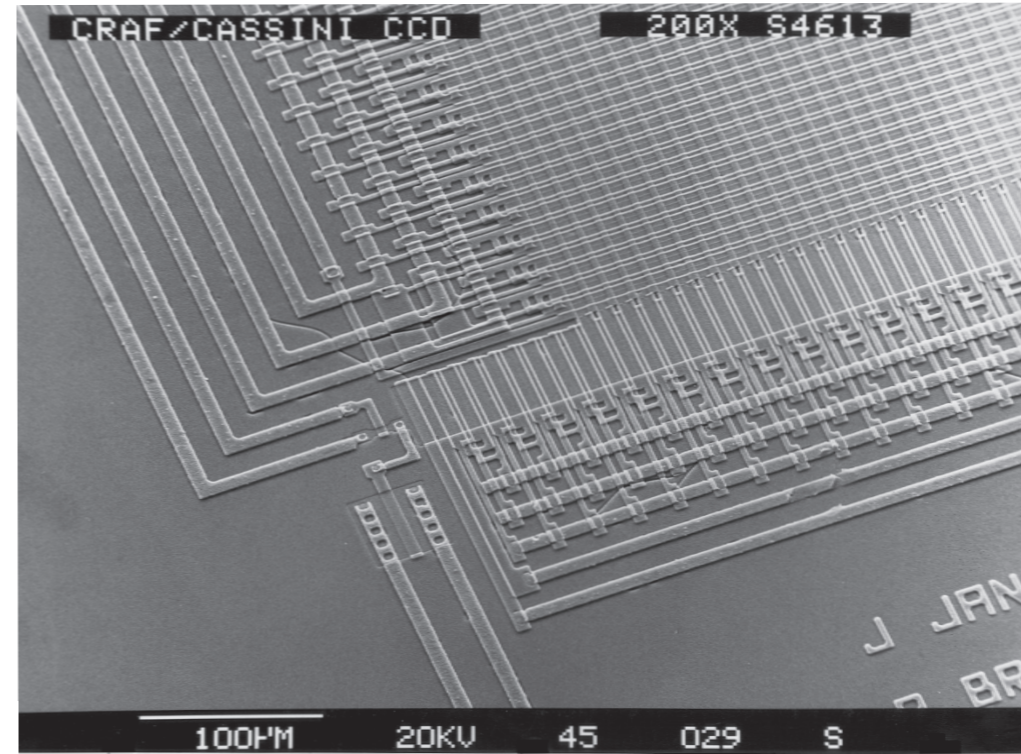
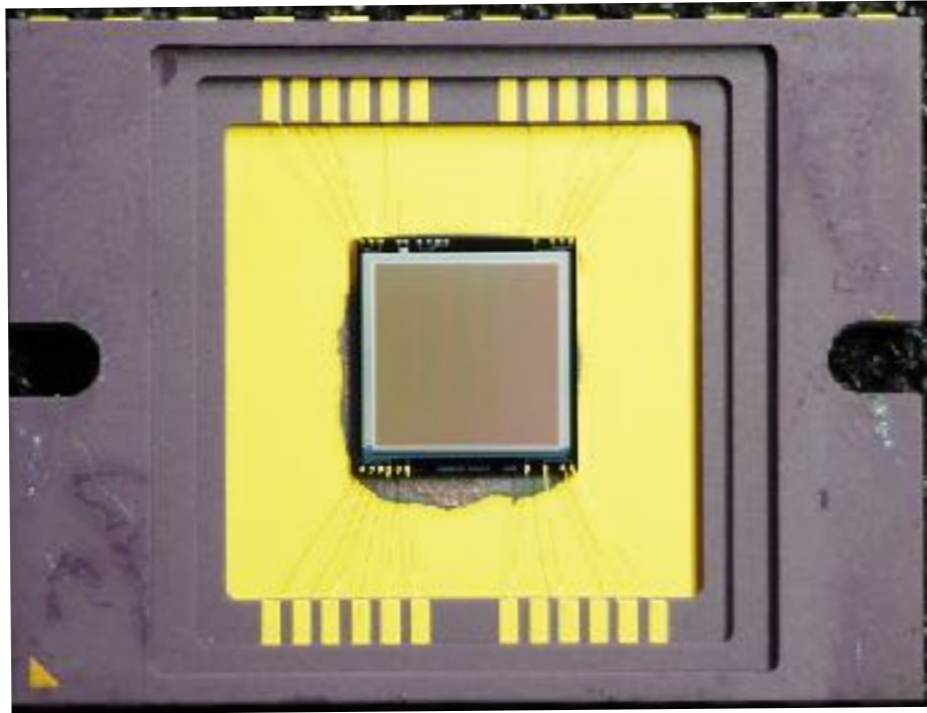


Figure 1.12(i) SEM photograph of the amplifier region.

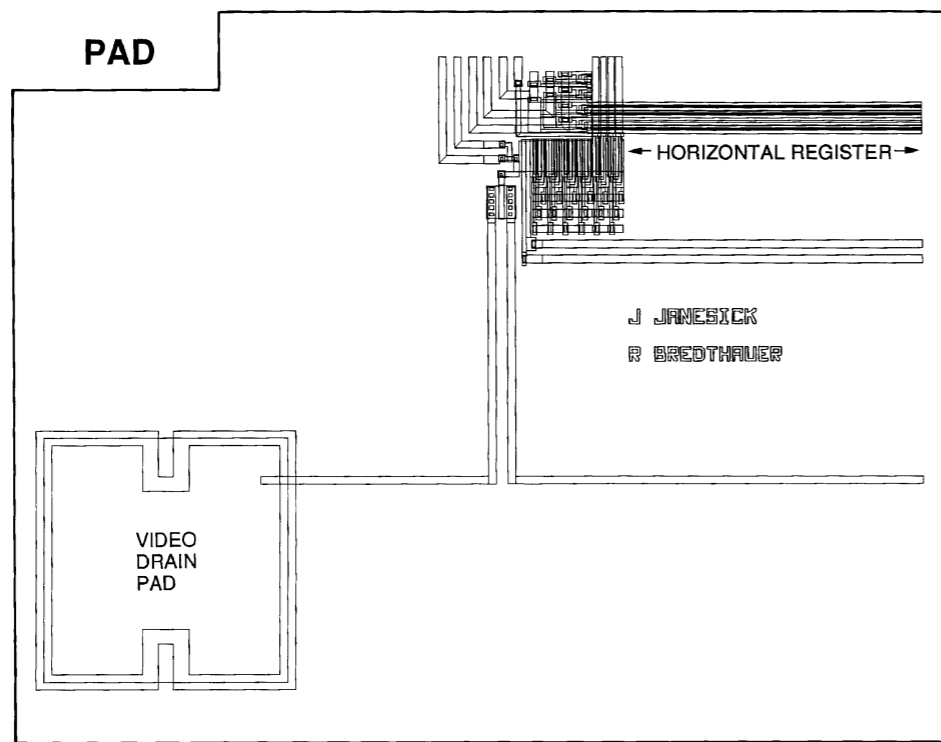


Figure 1.12(g) Pad mask.

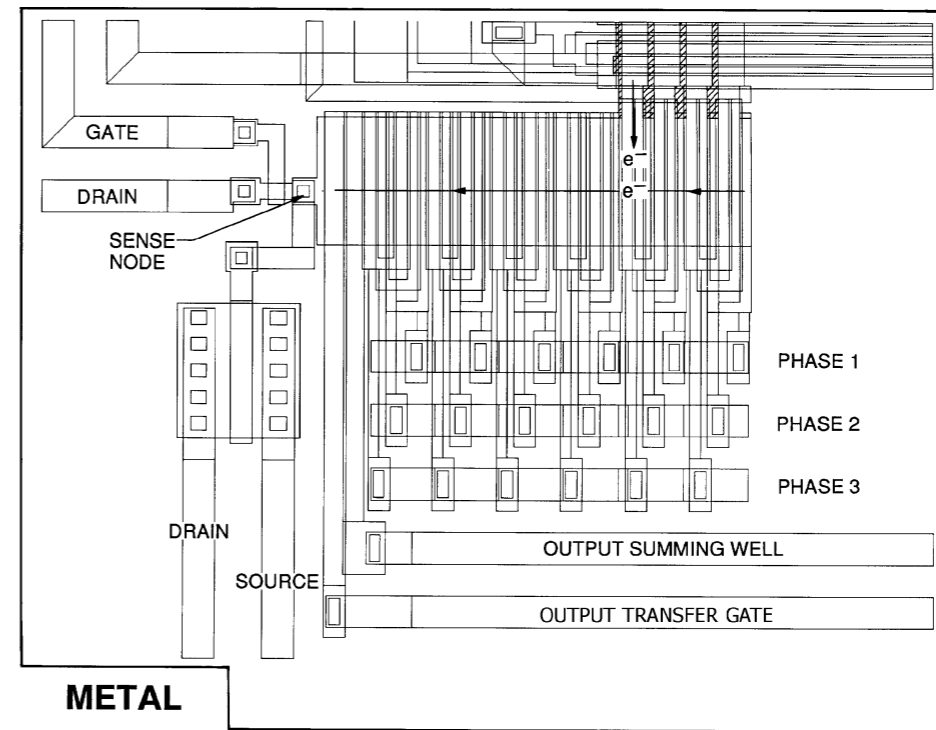


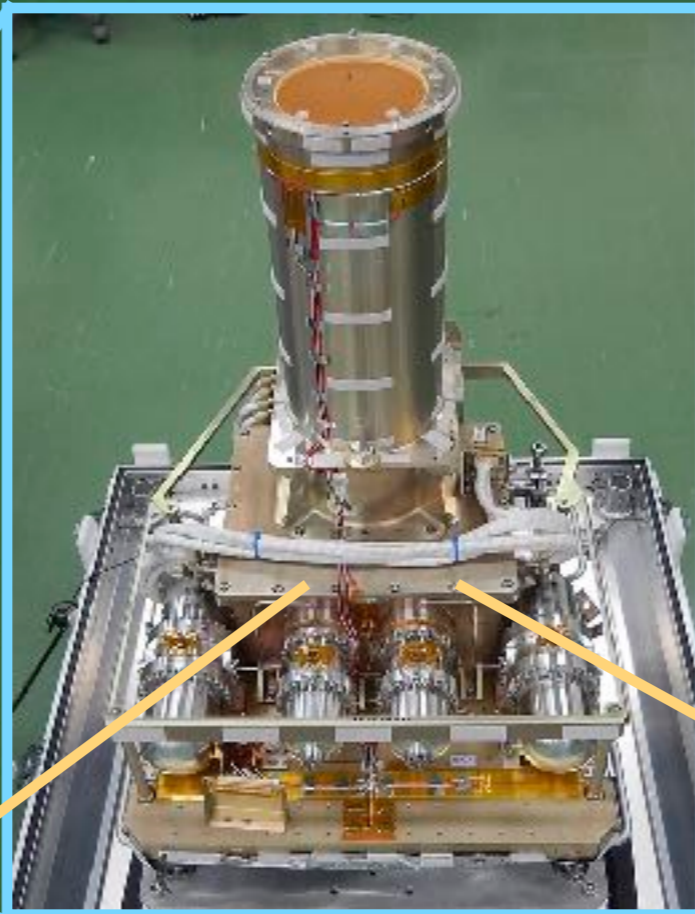
Figure 1.12(f) Metal mask.



# X-ray Astronomy CCD

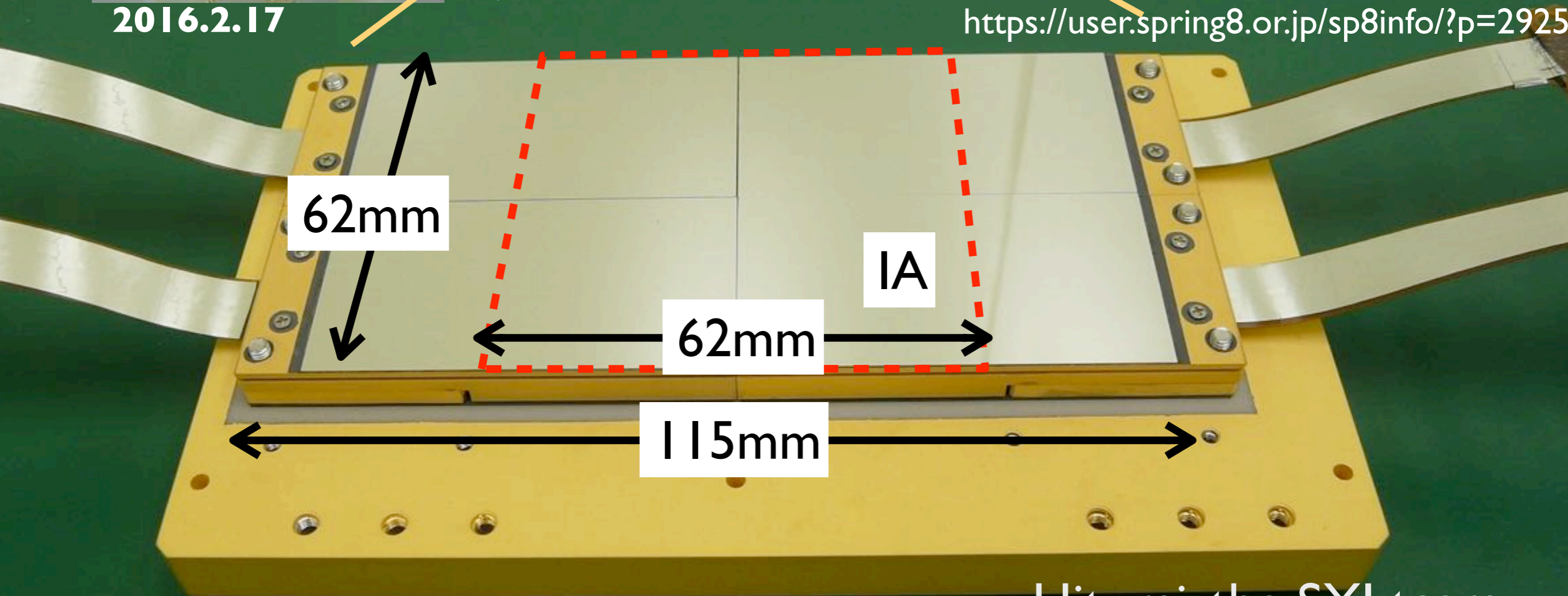


**Hitomi (Astro-H)**  
2016.2.17

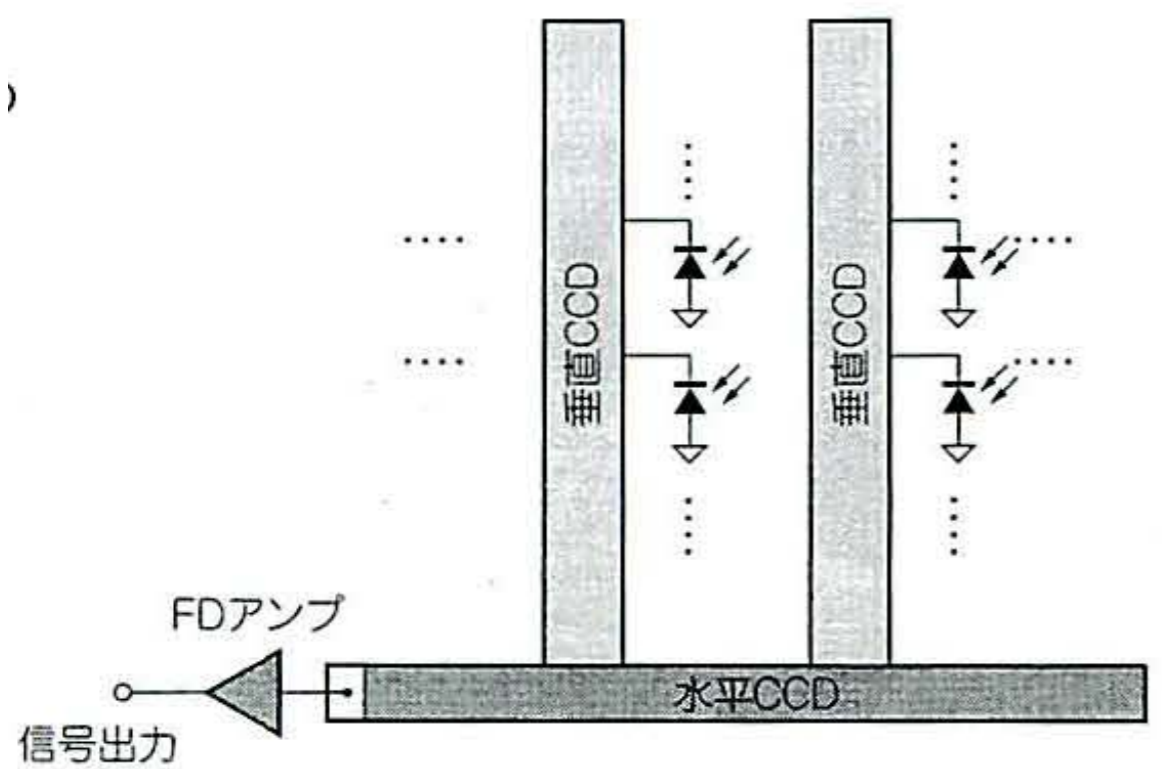


Focal assembly of the CCD camera of the Hitomi satellite.

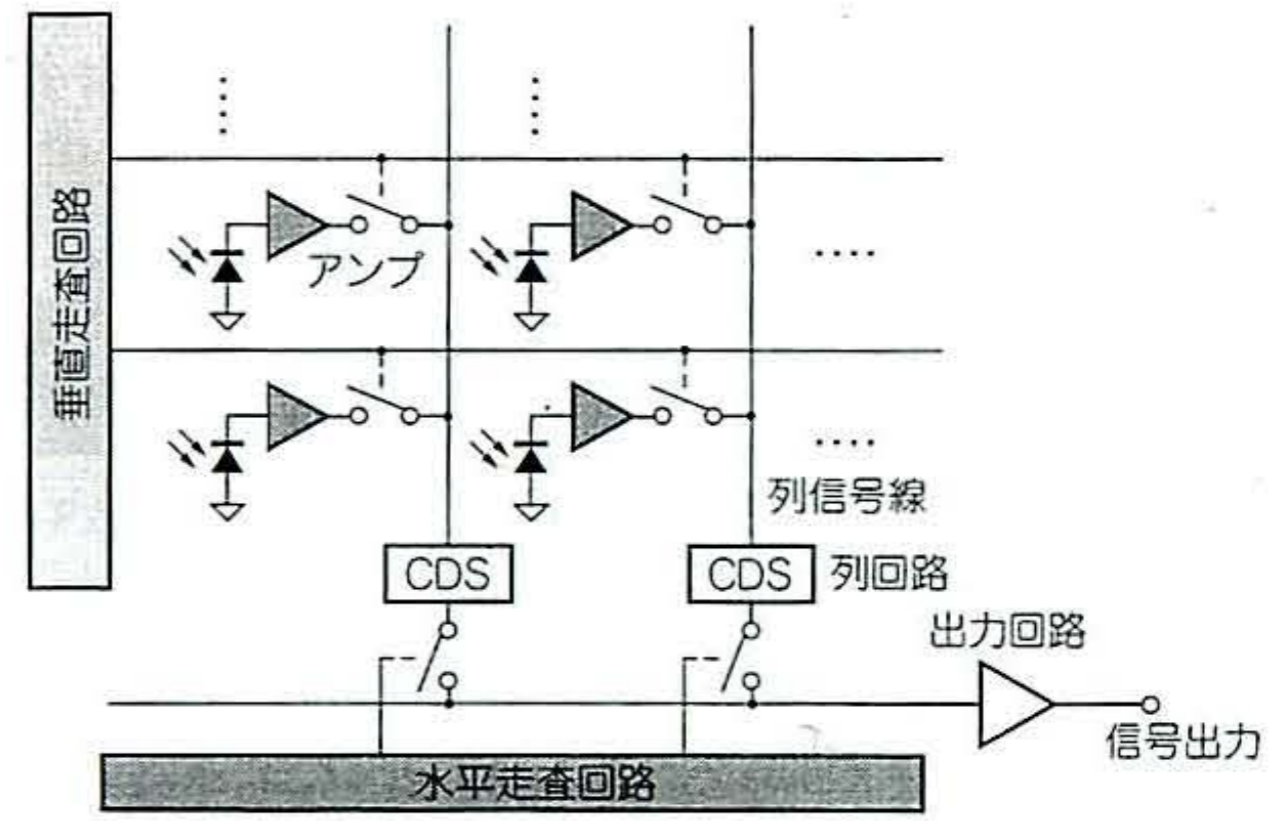
<http://astro-h.isas.jaxa.jp/diary/1329/>  
<https://user.spring8.or.jp/sp8info/?p=2925>



# CCD vs CMOS Imager Sensor



(a) CCDイメージ・センサ

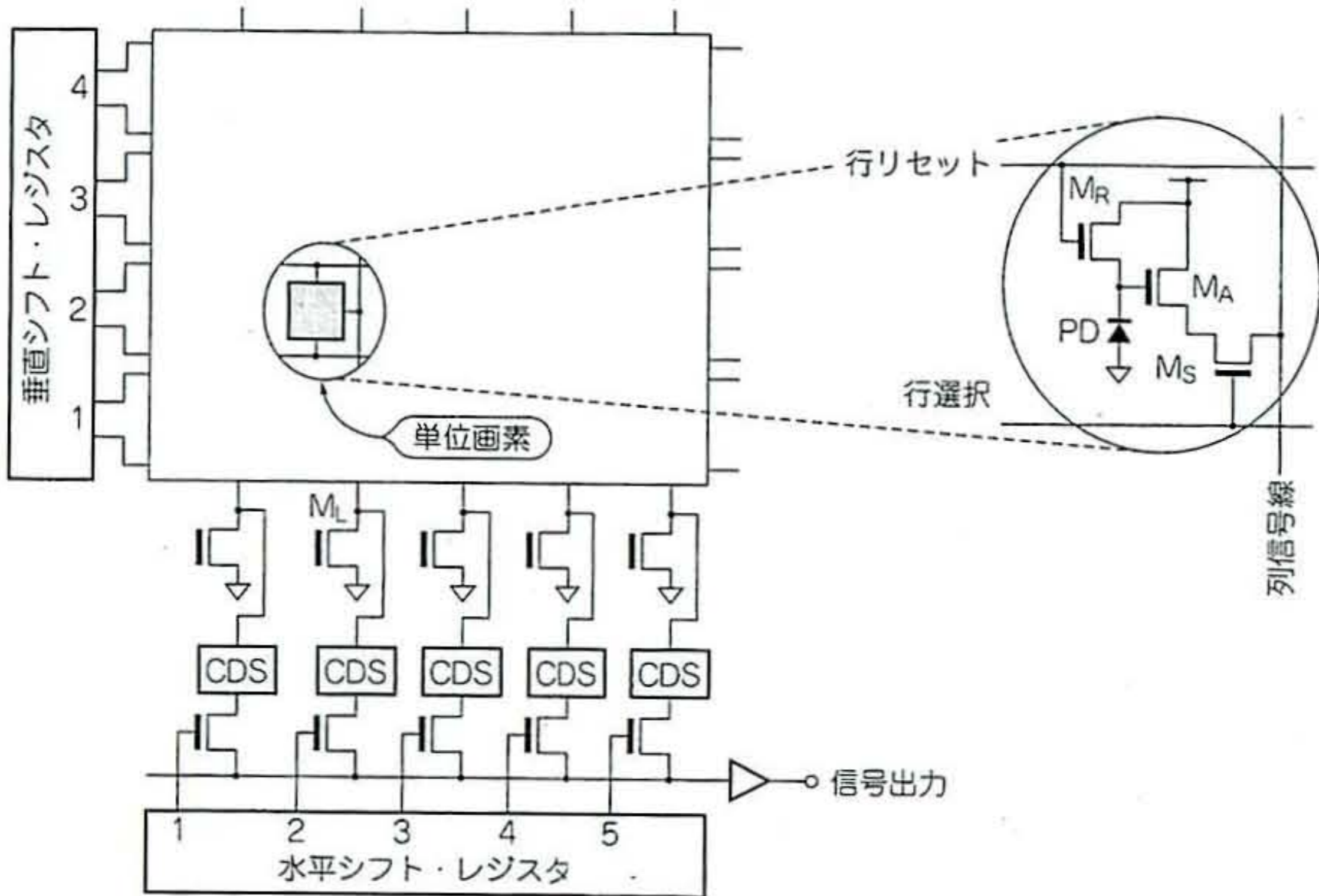


(b) CMOSイメージ・センサ



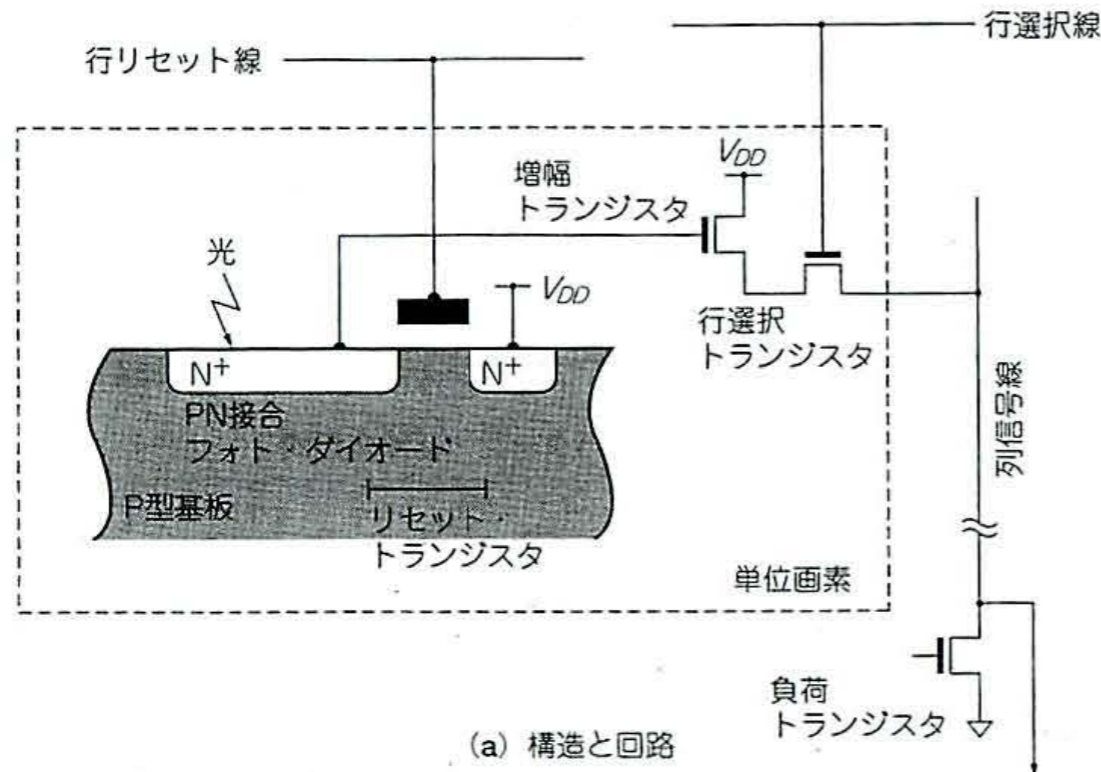
# CMOS Imager Sensor

〈図6-9〉 CMOSイメージ・センサの構成一例

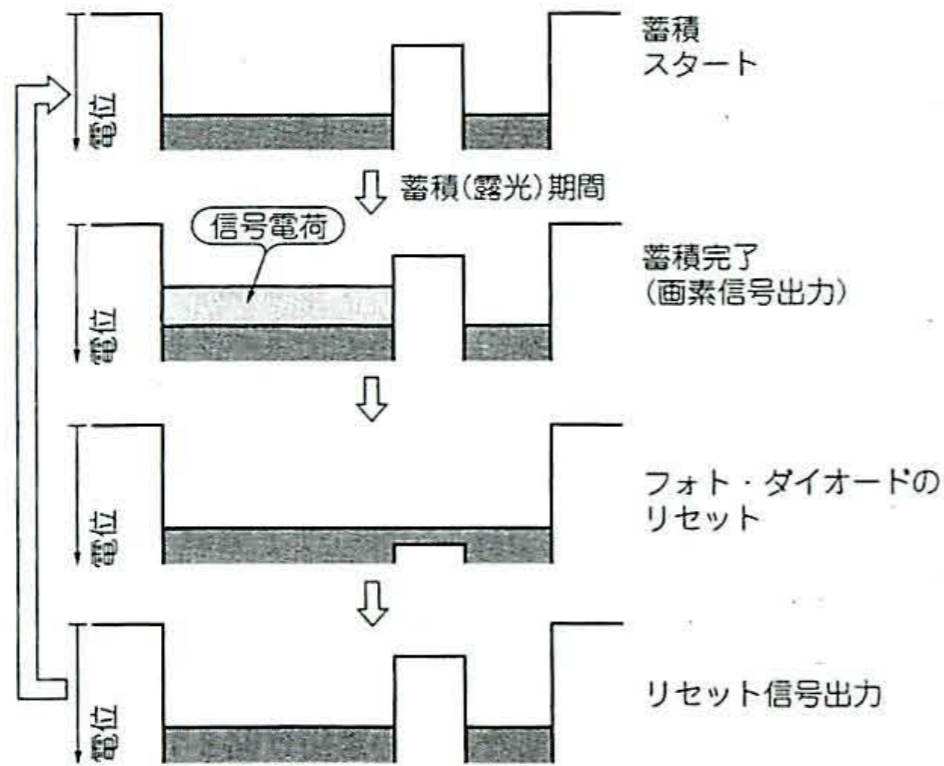


# CMOS Imager Sensor

〈図6-11〉PN接合フォト・ダイオード方式の構造とポテンシャル図

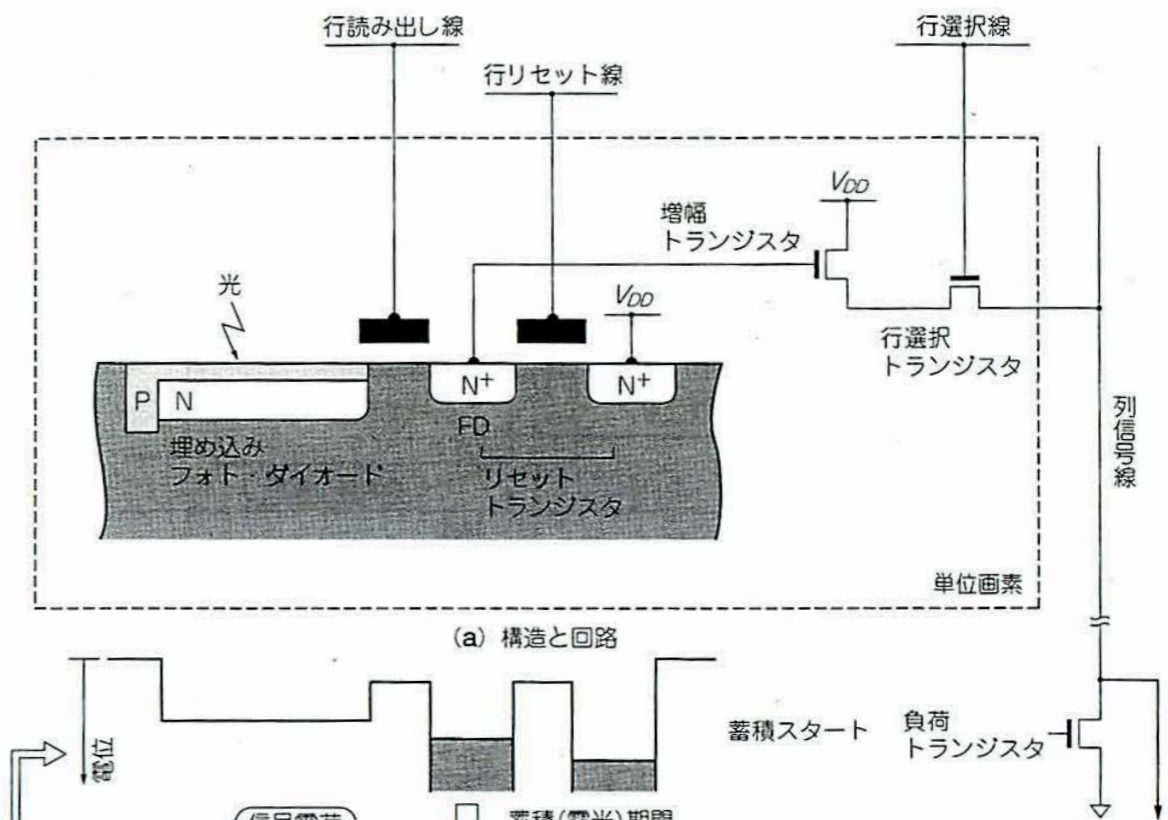


(a) 構造と回路

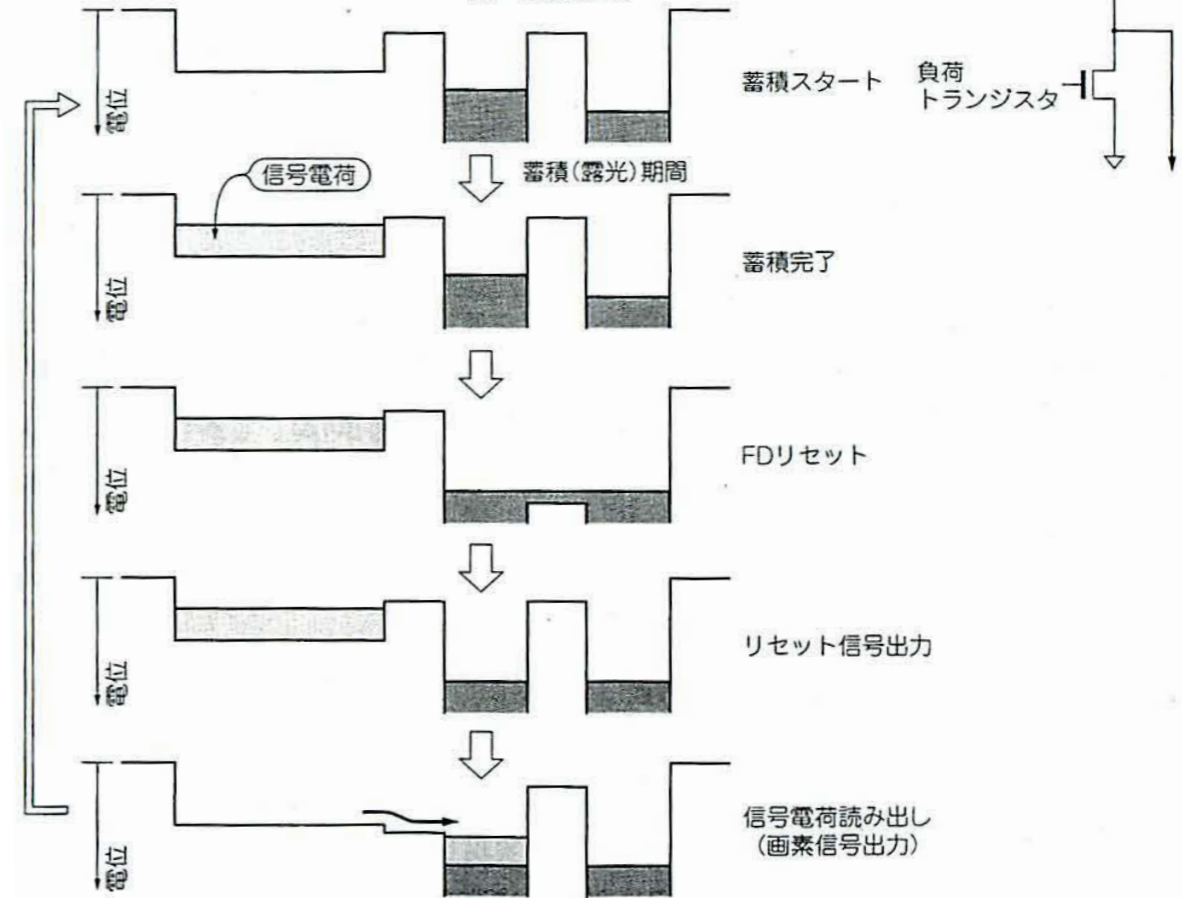


(b) 動作を示す電位分布図

〈図6-15〉埋め込みフォト・ダイオード+FD方式



(a) 構造と回路



(b) 動作を示す電位分布図