Planar Junction with Field Plate

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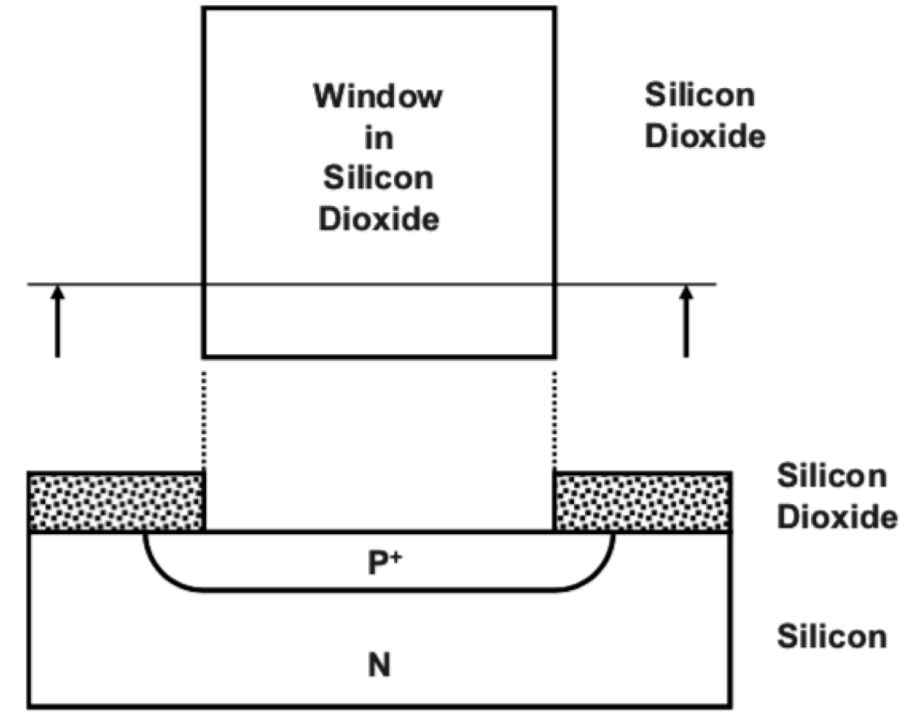
Planar Junction and Breakdown Voltage

The dopant can be diffused into the silicon surface exposed within the window by dopants introduced via the vapor phase or by low energy ion implantation.

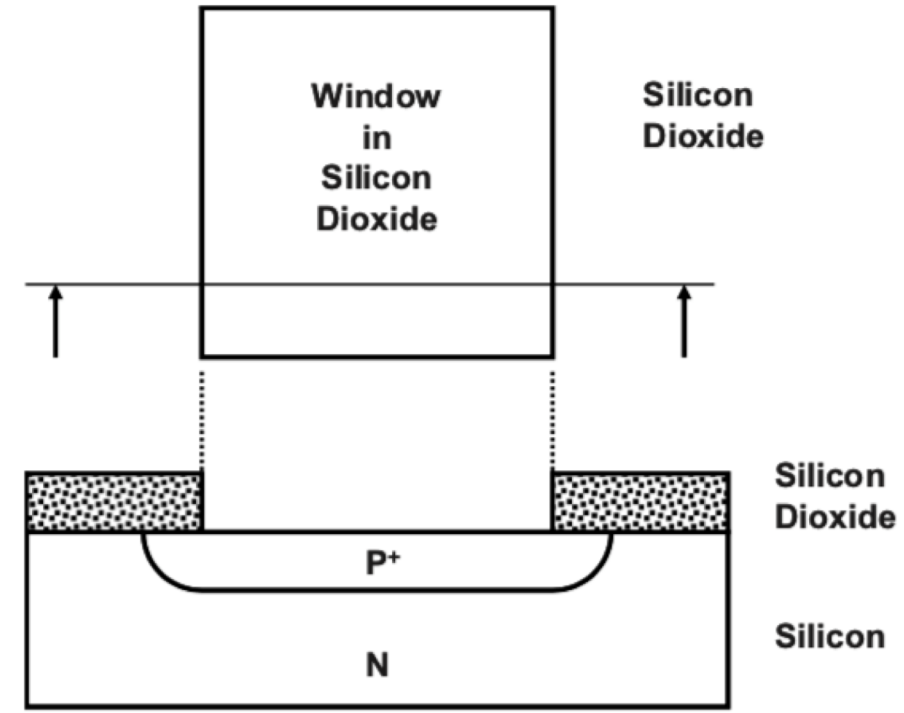
It is customary to thermally drive the dopant atoms into the silicon at elevated temperatures to produce junction depths appropriate for power devices.

The breakdown voltage of the planar junction is reduced by the presence of this junction curvature.



3D Simulation Better

At the corners of the rectangular diffusion window, a sharp point is formed. The dopants are driven in three dimensions away from this corner, producing a junction which is one-eight of a spherical surface. An even greater electric field enhancement occurs due to the presence of these spherical junctions at the four corners of the rectangular window. The breakdown voltage at these locations is even lower than that at the edges of the window where the cylindrical junctions are located.



Field Plate with Extra Bias

It has been found[13] that the breakdown voltage of the diode with the field plate (BV_{FP}) is related to the magnitude of the negative bias (V_{FP}) applied to the field plate:

$$BV_{FP} = mV_{FP} + K, \tag{3.70}$$

where m and K are constants. The value for m is close to unity especially for smaller field oxide thicknesses.

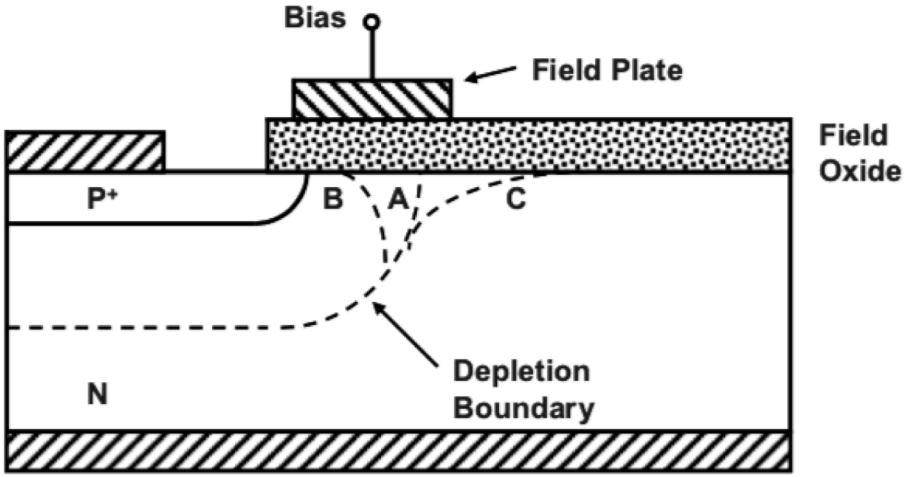


Fig. 3.33 Planar junction with biased field plate over the field oxide

Field Plate Thickness

$$x_J = \left(\frac{\varepsilon_{Si}}{\varepsilon_{OX}} \right) t_{OX} \approx 3 t_{OX}. \tag{3.71}$$

The breakdown voltage at the field plate for a field oxide thickness of 1 μm would be equivalent to the breakdown voltage of a cylindrical junction with a depth of 3 μm. Using this junction depth, the breakdown voltage can be obtained by using the analytical formulations developed for cylindrical junctions. However, it is

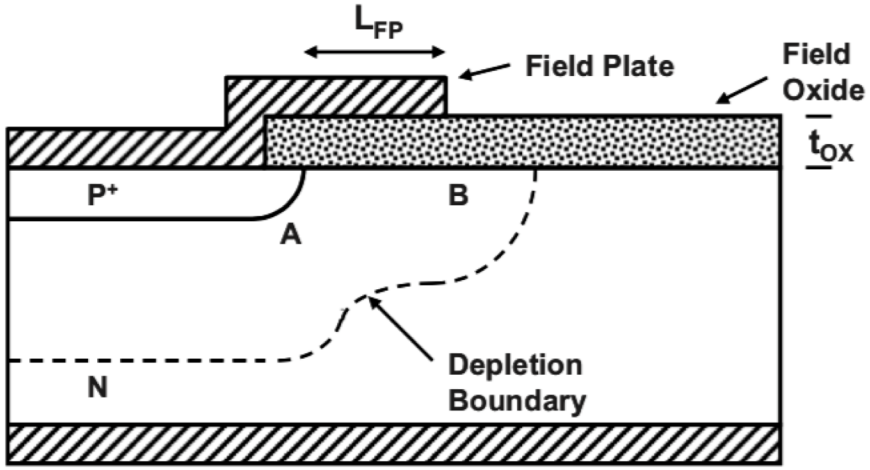


Fig. 3.34 Planar junction with metal field plate over the field oxide

Thanks for your listening!

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Field Ring

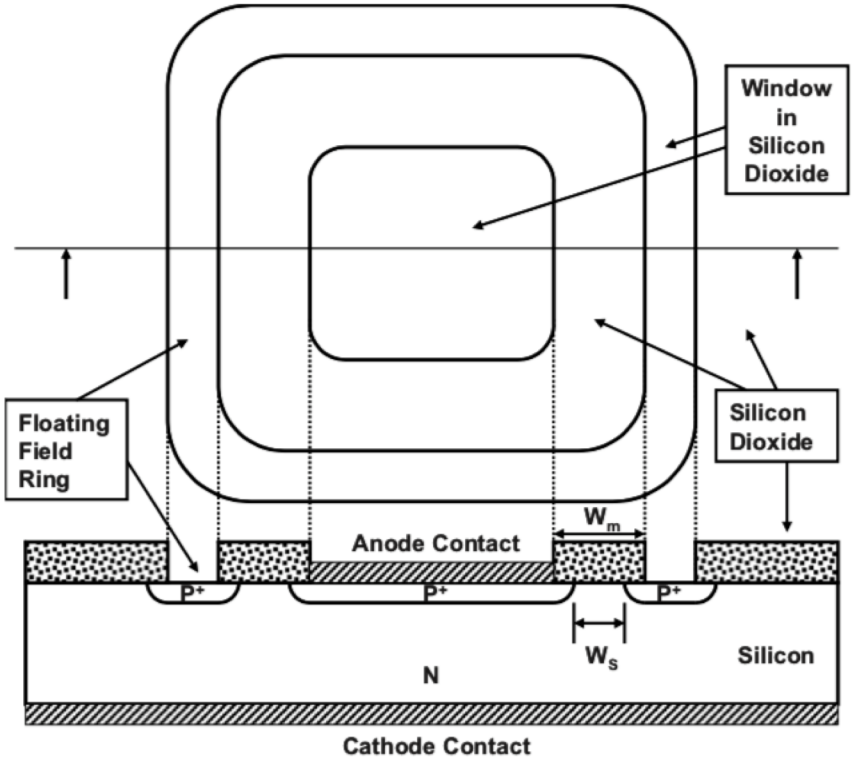

Fig. 3.20 The planar junction with floating field ring

Field Ring

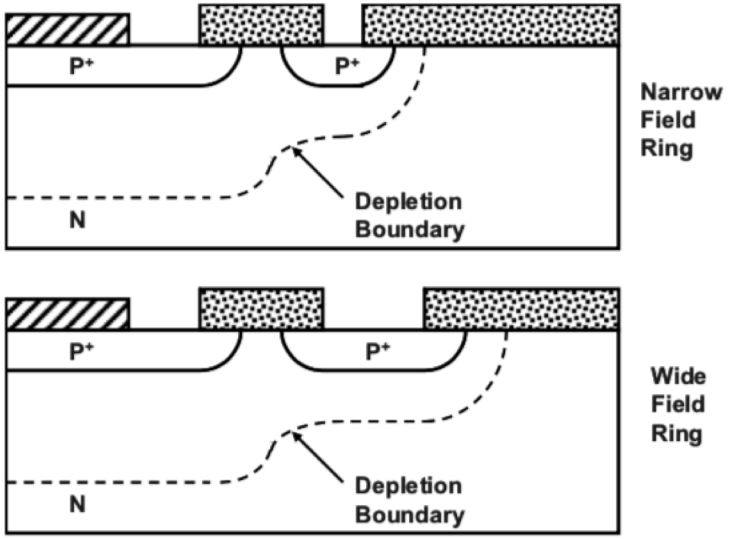

Fig. 3.30 Impact of the width of the floating field ring

Field Ring

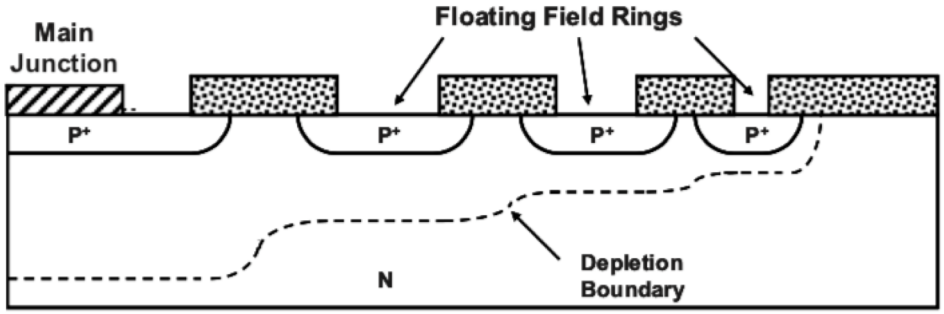

Fig. 3.31 Multiple floating field ring termination with graded spacing and width

Field Ring

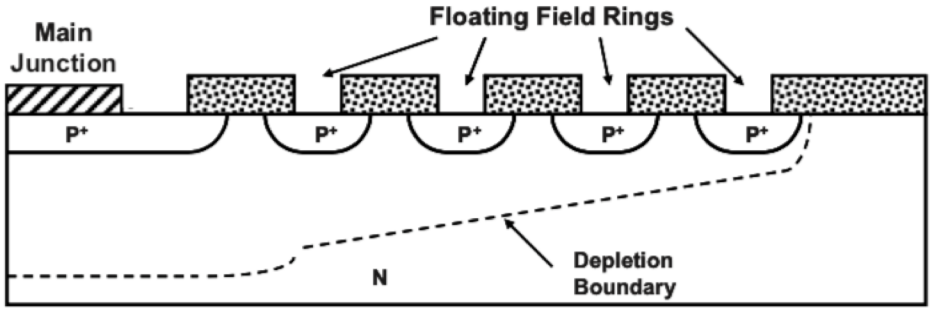

Fig. 3.32 Multiple floating field ring termination with equal spacing and width