a manner so as to not damage the image sensor device **30**, for example the sidewalls of the image sensor dies **300**A and **300**B.

The embodiments discussed above offer advantages over conventional image sensor devices, for example advantages in dark current performances. However, it is understood that not all advantages are necessarily discussed herein, and other embodiments may offer different advantages, and that no particular advantage is required for all embodiments.

Dark current is a common type of image sensor defect and may be defined as the existence of pixel current when no actual illumination is present. In other words, the pixel "detects" light when it is not supposed to. Dark current defects may be caused by stress in conventional image sensors. In more detail, the organic material filling the scribe-line region for conventional image sensors may have a high coefficient of thermal expansion. Thus, as temperature rises, the organic material expands in various directions, including in a lateral direction. The lateral expansion of the organic material causes stress to the radiation-sensing devices of the pixel region. This stress may induce a bandgap of a charge carrier to be narrowed, which may result in carrier leakage and therefore give rise to dark current in conventional image sensors.

In comparison, the image sensor device **30** discussed above minimizes dark current problems by not completely removing all portions of the substrate **40** in the scribe-line region **190**. In more detail, a substrate portion **40**A is retained when the scribe-line region **190** is etched. The retained substrate portion **40**A substantially reduces the amount of stress (caused by organic material expansion) that is delivered to the radiation-sensing regions **70**. One of the reasons why lateral stress is reduced is that the retained substrate portion **40**A has the same material composition as the substrate **40** and therefore does not have a thermal expansion coefficient as high as that of the organic material **260**. Hence, even as temperature rises, the substrate portion **40**A causes substantially no stress to the radiation-sensing region **70** nearby. Another reason is that the retained substrate portion **40**A separates the radiation-sensing region **70** from the organic material **260** in the scribe-line region **190**. Such separation effectively provides a "buffer" for stress caused by the thermal expansion of the organic material **190**. Therefore, the amount of lateral stress experienced by the radiation-sensing region **70** may be reduced by the retained substrate portion **40**A. For at least the reasons discussed above, due to the retained substrate portions **40**A, the amount of lateral stress is reduced for each image sensor die **300**A-**300**B, and consequently dark current performance is improved.

It is understood that the thickness of the retained substrate portion **40**A in the scribe-line region may be correlated with the amount of stress experienced by each of the image sensor dies **300**A-**300**B. Typically, a thicker substrate portion **40**A results in a smaller lateral stress for the image sensor dies **300**A-**300**B. However, the substrate portion **40**A cannot be too thick, because an excessive thickness may prevent the bonding pads **90**A from being "opened" as discussed above with reference to FIG. **7**. In other words, if the retained substrate portion **40**A is too thick, then the etching process **250** may not be able to completely etch away the layers covering the bonding pads **90** to expose their surfaces.

On the other hand, if the substrate portion **40**A is too thin, then it may not sufficiently reduce lateral stress against the image sensor dies **300**A-**300**B. Thus, a careful tradeoff must be made. As discussed above, according to the various aspects of the present disclosure, a thickness range of between about 0 Angstroms and 4000 Angstroms has been found to be suitable for reducing lateral stress while not interfering with bonding pad opening. It is understood, however, that other thickness ranges for the retained substrate portion **40**A may be used for alternative embodiments to accommodate different design requirements and manufacturing concerns. For example, in embodiments where the bonding pad opening is not a concern, the thickness of the retained substrate portion **40**A may be substantially greater than the range discussed herein, and possibly approaching the thickness of the substrate of the image sensor dies.

Another advantage of the embodiments of the present disclosure is that they are fully compatible with existing manufacturing processes. The implementation of the embodiments of the present disclosure merely involves tweaking existing fabrication processes. Therefore, no additional manufacturing equipment is needed, nor are additional fabrication steps performed. Consequently, the present disclosure does not increase fabrication costs or lengthen fabrication time.

It is understood that the sequence of the fabrication processes described above is not intended to be limiting. Some of the layers or devices may be formed according to different processing sequences in other embodiments than what is shown herein. Furthermore, some other layers may be formed but are not illustrated herein for the sake of simplicity.

One of the broader forms of the present disclosure involves an apparatus that includes: a semiconductor image sensor device having a non-scribe-line region and a scribe-line region, the semiconductor image sensor device including: a first substrate portion disposed in the non-scribe-line region, wherein the first substrate portion contains a doped radiation-sensing region; and a second substrate portion disposed in the scribe-line region, wherein the second substrate portion has the same material composition as the first substrate portion

In some embodiments, the scribe-line region is disposed adjacent to the non-scribe-line region.

In some embodiments, the first substrate portion and the second substrate portion each contain silicon.

In some embodiments, the second substrate portion is thinner than the first substrate portion.

In some embodiments, the first substrate portion has a first thickness less than about 3 microns; and the second substrate portion has a second thickness less than about 4000 Angstroms.

In some embodiments, the first substrate portion is in direct physical contact with the second substrate portion.

In some embodiments, the image sensor device further comprises: an organic portion disposed in the scribe-line region and over the second substrate portion.

In some embodiments, the image sensor device further comprises: an interconnect structure disposed over a front side of the first substrate portion and the second substrate portion; and an anti-reflective layer disposed over a back side of the first substrate portion and the second substrate portion.

Another one of the broader forms of the present disclosure involves an image sensor device that includes: a radiation-sensing region located in a silicon substrate, the radiation-sensing region being operable to sense radiation projected from a back side of the silicon substrate; a silicon component located adjacent to the silicon substrate; an organic component located over a back side of the silicon component; and