



Is diamond or silicon better for your application?

The tradeoff between using diamond radiation detectors (DRDs) and silicon diodes will depend on the brightness of your x-ray source, its spectral content and perhaps your desired time resolution.

DRDs can claim 200 ps (or better) resolution. Si diodes are typically a factor of 2 (or more) slower, depending on their size.

If your source emits P watts (through whatever filtration you may use), the detector is at a range R, the detector has an area A and sensitivity S (amps per watt), then the signal level into a 50 ohm load will be:

$$\text{Volts} = 50 * P * A * S / (4 \pi R^2).$$

Typical DRDs have areas of 1x1 to 1x3 mm². Typical silicon diodes, sensitive to few keV x-rays, have dimensions of 1x1 mm² or less.

A typical diamond DRD is 0.5 mm thick, so it can do a good job of detecting x-rays of energies up to about 5 keV. Thicker diamond DRDs can be made. A typical silicon detector has an effective thickness of 50 to 100 microns, which corresponds to good stopping power for x-ray energies up to 6 or 7 keV. Thicker diodes are available but with reduced frequency response.

Typical DRDs have sensitivities of 0.3 mA/W (with a 100 volt bias). Peak signal levels can be up to 10's of volts.

Silicon is about 1000X more sensitive: S is 0.27 A/W. Peak signal level should be kept to under a few volts to ensure linear response.

Both silicon diodes and DRDs must be biased (50 to 100 volts) through a "bias box".

Every healthy silicon diode will have a sensitivity of 0.27 A/W. Each healthy DRD must be calibrated as the value of S can vary by 4X.

Silicon diodes useful for few keV x-rays are relatively fragile. Diamond is diamond! That is, it is quite rugged.

For few keV x-rays and comparable detector sizes and ranges, the silicon sensor will be much more sensitive. If your source is weak, silicon is probably preferred. But if you need to locate the sensor close to the x-ray source, or you need many volt signals to deal with noise, or the source is relatively strong (or emits at higher photon energies), then a DRD may be preferred. The decision will depend on the details of your situation.