

## Semiconductor Detector Materials

Properties of materials used for room temperature semiconductor detectors

| Material   | Cd <sub>0.9</sub> Zn <sub>0.1</sub> Te | CdTe                 | Ge          | Si                 | GaAs               | Hgl <sub>2</sub>   | Pbl <sub>2</sub>   | a-Si                 | a-Se                 |
|--|--|----------------------|-------------|--------------------|--------------------|--------------------|--------------------|----------------------|----------------------|
| Atomic numbers                                     | 48, 30, 52                             | 48, 52               | 32          | 14                 | 31, 33             | 80, 53             | 82, 53             | 14                   | 34                   |
| Average atomic number                              | 49.1                                   | 50                   | 32          | 32                 | 32                 | 62                 | 62.7               | 14                   | 34                   |
| Density<br>$\rho$ (g/cm <sup>3</sup> )             | 5.78                                   | 5.85                 | 5.33        | 2.33               | 5.32               | 6.4                | 6.2                | 2.3                  | 4.3                  |
| Band gap<br>$E_g$ (eV)                             | 1.572                                  | 1.5                  | 0.67        | 1.12               | 1.43               | 2.13               | 2.32               | 1.8                  | 2.2                  |
| Dielectric Constant                                | 10.9                                   | 11                   | 16          | 11.7               | 12.8               | 8.8                |                    | 11.7                 | 6.6                  |
| Pair creation energy<br>$E_{pair}$ (eV)            | 4.64                                   | 4.43                 | 2.95        | 3.62               | 4.2                | 4.2                | 4.9                | 4                    | 7                    |
| Resistivity<br>$\rho$ ( $\Omega$ cm)               | $3 \times 10^{10}$                     | $10^9$               | 50          | $< 10^4$           | $10^7$             | $10^{13}$          | $10^{12}$          | $10^{12}$            | $10^{12}$            |
| Electron mobility<br>$\mu_e$ (cm <sup>2</sup> /Vs) | 1000                                   | 1100                 | 3900        | 1400               | 8000               | 100                | 8                  | 1                    | 0.005                |
| Electron lifetime<br>$\tau_e$ (s)                  | $3 \times 10^{-6}$                     | $3 \times 10^{-6}$   | $> 10^{-3}$ | $> 10^{-3}$        | $10^{-8}$          | $10^{-6}$          | $10^{-6}$          | $6.8 \times 10^{-9}$ | $10^{-6}$            |
| Hole mobility<br>$\mu_h$ (cm <sup>2</sup> /Vs)     | 50 – 80                                | 100                  | 1900        | 480                | 400                | 4                  | 2                  | 0.005                | 0.14                 |
| Hole lifetime<br>$\tau_h$ (s)                      | $10^{-6}$                              | $2 \times 10^{-6}$   | $10^{-3}$   | $2 \times 10^{-3}$ | $10^{-7}$          | $10^{-5}$          |                    | $4 \times 10^{-6}$   | $10^{-6}$            |
| $(\mu\tau)_e$<br>(cm <sup>2</sup> /V)              | $(3-5) \times 10^{-3}$                 | $3.3 \times 10^{-3}$ | $> 1$       | $> 1$              | $8 \times 10^{-5}$ | $10^{-4}$          | $8 \times 10^{-6}$ | $6.8 \times 10^{-8}$ | $5 \times 10^{-9}$   |
| $(\mu\tau)_h$<br>(cm <sup>2</sup> /V)              | $5 \times 10^{-5}$                     | $2 \times 10^{-4}$   | $> 1$       | $\approx 1$        | $4 \times 10^{-6}$ | $4 \times 10^{-5}$ |                    | $2 \times 10^{-8}$   | $1.4 \times 10^{-7}$ |