

Avalanche Photo-Diodes Present Choices / Future Possibilities

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McIntyre derived more than 30 years ago the avalanche photodiode (APD) multiplication theory. Even now, it is the theory most often used. For very narrow multiplication regions that of Van Vliet [2] may give better results. The APDs multiplication process will be reviewed and the various properties (e.g. gain, noise, speed) discussed.

While the theory has not changed much over the years, a number of APD structures (Reach-Through, Bevel Edge, Front Entry, Buried Junction) have been developed. They are available in various flavours and can be procured from several manufacturers. These will be reviewed, and the pro and cons of each one will be discussed.

Operating conditions will also be discussed and specific examples to optimise measurements will be presented.

To some extent, APDs can be tailored to meet specific requirements (low/high x-ray energy, low noise). However performance parameters (e.g. timing, operating voltage, efficiency, gain, noise...) are interrelated, and improving one often impacts negatively another parameter.

Several possible directions of development – thicker absorption region, faster avalanche, imaging arrays – will be presented.

References

[1] – R. J. McIntyre, IEEE Trans. Electron Devices ED-19, 704 (1972).

[2] – K. M. van Vliet, and L. M. Rucker IEEE Trans. Electron Devices ED-26, 746 (1979)