SELECTED TOPICS IN ADVANCED ELECTRONICS

Edited by

Khalid A. S. Al-Khateeb

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INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

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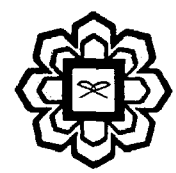

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CHAPTER 34

NEUTRON SOURCE AND NEUTRON SHIELDING

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Synopsis

Exposure to neutron radiation may change the doping profile of a diode [1]. This chapter will include information on sources of neutron radiation and its interaction with matter. Neutron sources contained certain percentage of gamma rays that requires to be filtered out to only obtain neutron component from the neutron source or reactor. Neutron source such as ^{252}Cf can generate fluences up to 10^{13} n/cm^2 and a reactor is needed to achieve higher neutron fluences [2]. Several filtering techniques are also discussed.

1. Sources of Neutron Radiation

Neutron was first discovered in 1932 by Chadwick [3]. Neutron radiation is a non-ionizing radiation where it does not ionize atoms in the same way charged particles such as protons and electrons because neutrons have no charge. However, Neutron irradiation causes indirect ionisation to occur as high energy particles collide with the atomic structure removing or adding an electron to an atom. Neutrons are mainly produced by reaction with alpha particles or photon, spontaneous and induced nuclear fission. Spontaneous fission is a quantum mechanical process which involves the penetration of a potential barrier. The height of the barrier and fission rate is very sensitive to atomic number, Z and atomic mass, A. The fission rates are different for different Z-A isotopes. Odd-even isotopes have fission rates typically 10^3 lower than the rate for even-even isotopes. Examples of even-even isotopes with high spontaneous fission yields are ^{238}U, ^{240}Pu, ^{244}Cm and ^{252}Cf [4]. ^{252}Cf isotope is the most commonly used neutron source as it is portable and suitable for laboratory work. The overall characteristics of ^{252}Cf are shown in the table below.