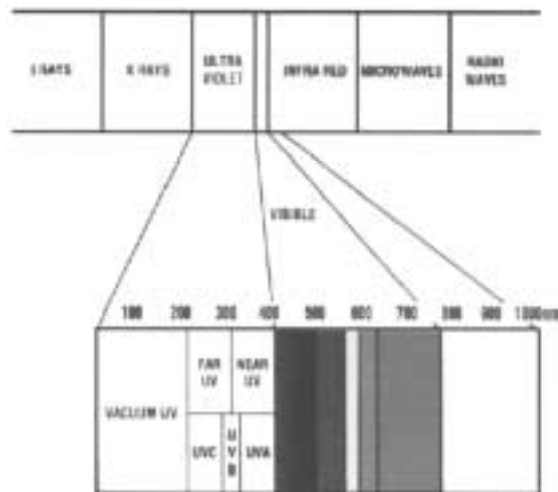


GaN P-I-N

Group III-Nitride UV Detectors

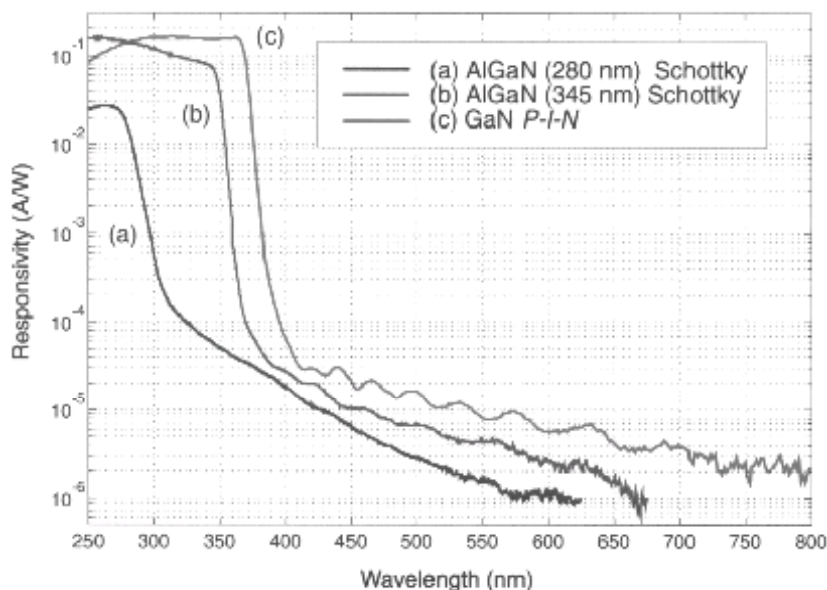
IIIB		IVB		VB	
5 4275 2300 2.34 1s ² 2s ² Boron	10.81 3 B	6 4470* 4100* 2.62 1s ² 2s ² p ² Carbon	12.011 4 C	7 77.35 63.14 1.251* 1s ² 2s ² p ² Nitrogen	14.0067 5 N
13 2793 833.25 2.70 [Ne]3s ² Aluminum	26.98154 3 Al	14 3540 1685 2.33 [Ne]3s ² p ² Silicon	28.0855 4 Si	15 550 317.30 1.82 [Ne]3s ² p ³ Phosphorus	30.97376 5 P
31 2478 302.90 5.91 [Ar]3d ¹⁰ 4s ¹ Gallium	69.72 3 Ga	32 3107 1216.4 3.32 [Ar]3d ¹⁰ 4s ² Germanium	72.59 4 Ge	33 876 317.30 5.72 [Ar]3d ¹⁰ 4s ² p ³ Arsenic	74.9216 5 As
49 2344 429.76 7.31 [Kr]4d ¹⁰ 5s ¹ Indium	114.82 3 In	50 2876 505.06 7.30 [Kr]4d ¹⁰ 5s ² Tin	118.69 4 Sn	51 1860 904 6.68 [Kr]4d ¹⁰ 5s ² p ³ Antimony	121.75 5 Sb

The group-III nitride material system offers the potential for solid state photonic detectors operating in the UV-A, UV-B, and UV-C spectral ranges. The group III-nitrides are so-called because they are formed from elements (Al, Ga, and In) in the third column of the periodic table with nitrogen. They are a subset of the III-V compound semiconductors that are all formed from elements in columns III and V of the periodic table. More familiar III-V semiconductors are GaAs, GaP, and ternary vibrations such as AlGaAs. The distinction for the III-nitrides is that their bandgaps fall in the energy range corresponding to blue and ultraviolet wavelengths. The bandgap of a ternary III-nitride material, i.e. InGaN and AlGaN, and be tailored by varying the relative percentages of the group III elements. For example, the



aluminum/63% gallium AlGaN ternary semiconductor is 4.4 eV, which corresponds to a photon wavelength of 280nm, the long wavelength edge of the UV-C band. By comparison, silicon, the most common semiconductor material for photodetectors, has a bandgap of 1.1 eV, corresponding to a wavelength of 1100nm in the infrared.

Responsivity of Group III-Nitride (GaN & AlGaN) Photodetectors



The figure to the left show the photovoltaic responsivity of three AlGaN photodiodes of differing aluminum compositions, a) 37% Al, b) 7% Al, and c) 0% Al, i.e. GaN. As the aluminum fraction increases, the material bandgap moves to higher energies, and the responsivity edge shifts to shorter wavelengths.