**Semiconductor Ultraviolet Optical Sources for Biological Agent Detection**

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In this paper we will discuss DARPA's new program in short-wavelength ultraviolet semiconductor optical sources (SUVOS), and their potential application to biological agent detection, as well as other military applications. Specifically, there is considerable interest in miniaturizing "detect-to-warn" bio-sensors. Currently, DoD is developing a sub-system known as the Biological Aerosol Warning System (BAWS) (Figure 1) for the Joint Biological Point Detection System (JBPDS). The BAWS works on the principle of laser induced fluorescence (LIF), in which an ultraviolet laser beam interacts with a flowing particle stream such that fluorescence is generated when particles containing biological agents are present (Figure 2). A future goal is the reduction in size, weight, power consumption, and cost of this system.

Semiconductors have the potential to be extremely efficient light sources. They also lend themselves to very small form factors, high wall-plug efficiency, and potentially very low cost. Unfortunately, at present, although the entire visible spectrum is attainable with optoelectronic devices fabricated from III-V materials, semiconductor UV optical sources still elude researchers. Semiconductor UV sources could be used in LIF based detection systems to effect ultra-miniaturization of the bio-sensor. In order to accomplish this goal, we must develop both laser diodes (LD) and light emitting diodes (LED) that can operate at wavelengths as short as 280 nm (the peak absorbance of tryptophan), as well as at wavelengths in the 340 nm range (for excitation of NADH). Also, new system concepts and associated optical architectures will be required in order to construct truly miniaturized bio-sensors.

Recent work in the $Al_xIn_yGa_{1-x-y}N$ material system suggests that optoelectronic devices working in the mid-UV are attainable. The primary challenges are solving the ubiquitous problem of *p*-doping of high Al content materials (needed to reach the UV portion of the spectrum), suppressing non-radiative recombination in the gain region, developing good ohmic contacts, reducing heterojunction offsets, and fabricating high reflectivity mirrors. We will discuss the issues associated with each of these challenges, and present preliminary solutions that address these problems.

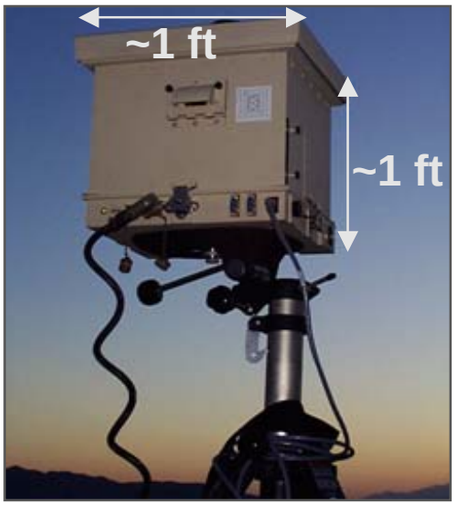


Figure 1. Biological Aerosol Warning System (BAWS)

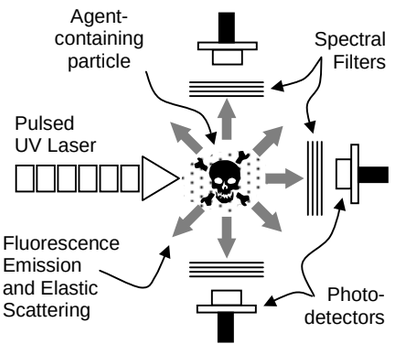


Figure 2. Laser Induced Fluorescence bio-agent detection system