# Improved, Scalable, Optical Particle/Molecule Detector System by Solid State Energy Sources (Case 1494)

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## Technology description

Brief Description:
With environmental safety and defense/bioterrorism concerns, and the continuing drive for important medical breakthroughs, quick and accurate particle diagnostic capabilities have become increasingly important to identify and quantify biological/environmental contaminants and to assay biological substances such as anthrax spores in air or reticulocytes in blood. Numerous and varied particle detection approaches exist, but require precise alignment of independent components typically mounted in a laboratory as a semi-permanent system. Portable gas chromatographs/mass spectrometers (GC/MS) remain expensive and often overly complicated for field personnel. Flow cytometers for blood analysis are more commonplace, but usually employ an expensive argon laser and cannot detect particles in air. Raman and light scattering spectroscopy each have the following practical equipment and technical limitations: both techniques require a fixed laboratory installment and high-powered laser; related light optics may be too sensitive and thus incompatible with rigorous field work; and light scattering detects particles based on size and may be unable to distinguish between similarly sized particles unless a trigger signal with an identification sensing system is employed. Hence, there is compelling need for a portable optical particle diagnostic system to qualitatively identify target particles/molecules, especially biological contaminants.

The technology is an improved, efficient, cost effective device for field identification of target particles such as bioagents, environmental contaminants, or any other particle/molecule that can be made to fluoresce or phosphoresce – naturally or by selective binding. The innovation is a method to produce the scalable, optical particle detector system. The versatile system can be scaled using planar micro-optical and microfluidic components to enable miniaturization of the complete detector system for chip-scale UV detection.

Most simply, the system is comprised of an interrogation chamber between an acquisition/entry and privation/exit point, a solid-state energy source (e.g., LED, DL, UV emitter, laser) for photoexcitation or the imparting of energy to the particle, and a re-emission sensor for detecting fluorescence or phosphorescence, which includes an arcuate or multi-planar lens to focus re-emitted energy. A scanner re-directs the beam from a single energy source to track the particle between the entry and exit points,

or from a plurality of source elements that can scan the particle at a single position. The particle is identified by its re-emitted energy spectrum.

In this novel system, particle movement relative to the photoexcitation beam is used to impart energy to the particle over a longer time period (order of a milliwatt for a millisecond), than existing systems, to overcome low energy absorption of the particle due to the inherent low power of solid-state UV sources. The approach is flexible; the photoexcitation beam may be monochromatic, broadband or filtered, and the scanner may be based on acousto-optics, MEMS, or electro-optics. Target particles may be bound to a substrate or suspended in a carrier fluid/air. Potential exists for system use with a variety of solid-state semiconductor optical sources, such as light emitting diodes (LEDs), diode lasers (DLs), and other UV emitters, for short visible, near ultraviolet and ultraviolet spectral ranges. A choice of optical sources offers advantages of small size (cm to mm) and low fabrication cost depending upon application requirements. Advantageously combining the invention with high efficiency, microscale semiconductor-based UV emitters results in a portable, highly compact fluorescence-based diagnostic system with a range of remote uses from effective, rapid bioagent warning to biochemically specific assay techniques.
Field or laboratory applications are many and include: detecting and quantifying particles or (bio)molecules in air or fluids (such as in military or civilian defense against bioterrorism testing/ monitoring of an environment), medical diagnostics (e.g., testing for specific molecules in the blood, lymph or lungs (air) via direct or tagged detection assays), and for use in scientific and/or biomedical research tools for R&D experiments involving light scattering from very small particles, particle detection/identification and quantification. Markets include: pharmaceutical – diagnostic medical devices; environmental test/monitor instruments; advanced scientific analytical research instruments. Market niches may be in portable or non-portable devices in each of the broader markets.

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