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(54) **SPECTROSCOPIC CHEMICAL ANALYSIS
METHODS AND APPARATUS**

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patent is extended or adjusted under 35
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filed on Mar. 6, 2009, now Pat. No. 7,800,753, which is
a continuation of application No. 11/245,486, filed on
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(58) **Field of Classification Search** **356/317,**
356/318, 301, 326, 417

See application file for complete search history.

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(57) **ABSTRACT**

Spectroscopic chemical analysis methods and apparatus are disclosed which employ deep ultraviolet (e.g. in the 200 nm to 300 nm spectral range) electron beam pumped wide bandgap semiconductor lasers, incoherent wide bandgap semiconductor light emitting devices, and hollow cathode metal ion lasers to perform non-contact, non-invasive detection of unknown chemical analytes. These deep ultraviolet sources enable dramatic size, weight and power consumption reductions of chemical analysis instruments. Chemical analysis instruments employed in some embodiments include capillary and gel plane electrophoresis, capillary electrochromatography, high performance liquid chromatography, flow cytometry, flow cells for liquids and aerosols, and surface detection instruments. In some embodiments, Raman spectroscopic detection methods and apparatus use ultra-narrow-band angle tuning filters, acousto-optic tuning filters, and temperature tuned filters to enable ultra-miniature analyzers for chemical identification. In some embodiments Raman analysis is conducted along with photoluminescence spectroscopy (i.e. fluorescence and/or phosphorescence spectroscopy) to provide high levels of sensitivity and specificity in the same instrument.

29 Claims, 13 Drawing Sheets

