US 20050279949A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2005/0279949 A1

Oldham et al. (43) Pub. Date: Dec. 22, 2005

(54) TEMPERATURE CONTROL FOR LIGHT-EMITTING DIODE STABILIZATION

(75) Inventors: **Mark F. Oldham**, Los Gatos, CA (US); **Vinod L. Mirchandani**, Oak Park, CA (US)

Correspondence Address:
KILYK & BOWERSOX, P.L.L.C.
3603 CHAIN BRIDGE ROAD
SUITE E
FAIRFAX, VA 22030 (US)

(73) Assignee: **Applera Corporation**, Foster City, CA

(21) Appl. No.: **10/981,440**

(22) Filed: **Nov. 4, 2004**

Related U.S. Application Data

(63) Continuation-in-part of application No. 10/440,719, filed on May 19, 2003, which is a continuation-in-part of application No. 10/216,620, filed on Aug. 9, 2002, which is a continuation of application No. 09/700,536, filed on Nov. 29, 2001, now Pat. No. 6,818,437.

(30) **Foreign Application Priority Data**

May 17, 1999 (WO) PCT/US99/11088

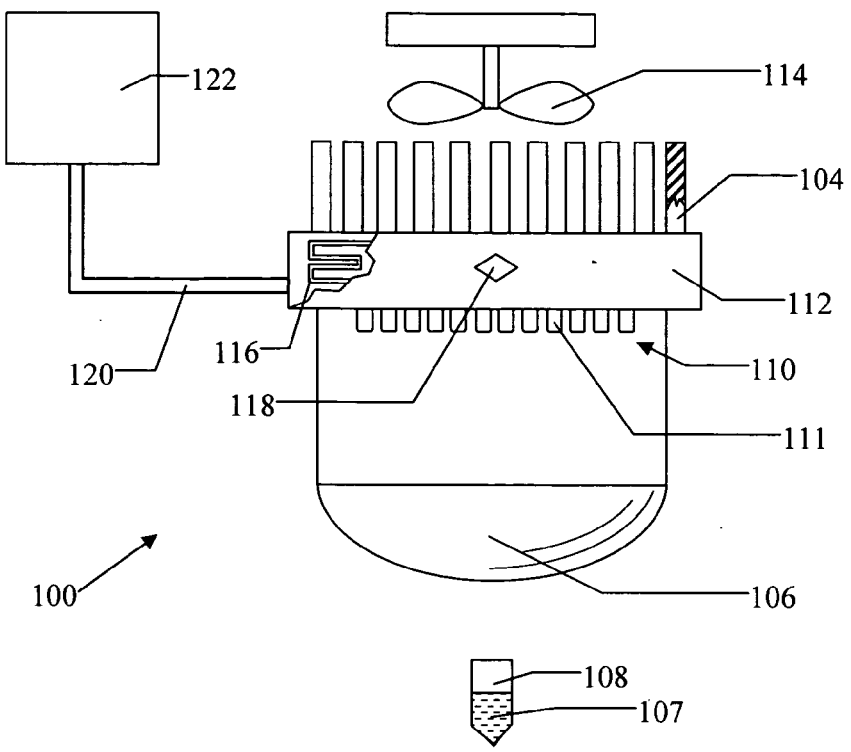
Publication Classification

(51) **Int. Cl.**[7] **G01N 21/01**; F21V 9/16

(52) **U.S. Cl.** **250/458.1**; 356/244

(57) **ABSTRACT**

A system is provided that includes a light-emitting diode (LED); a temperature sensor in thermal contact with the LED and capable of measuring an operating temperature and generating an operating temperature signal; and a temperature regulating system capable of receiving the operating temperature signal and regulating the operating temperature based on the operating temperature signal. A method for stabilizing the temperature of an LED is provided. A method is provided that includes providing a system comprising an LED, a reaction region, and a sample in the reaction region; generating excitation beams with the LED; directing excitation beams to the sample; detecting an optical property of the sample to obtain detection data; measuring the operating temperature of the light emitting diode; and adjusting the detection data of an excitation beam characteristic shift related to the operating temperature, when the LED is operated at the operating temperature to generate the excitation beams.



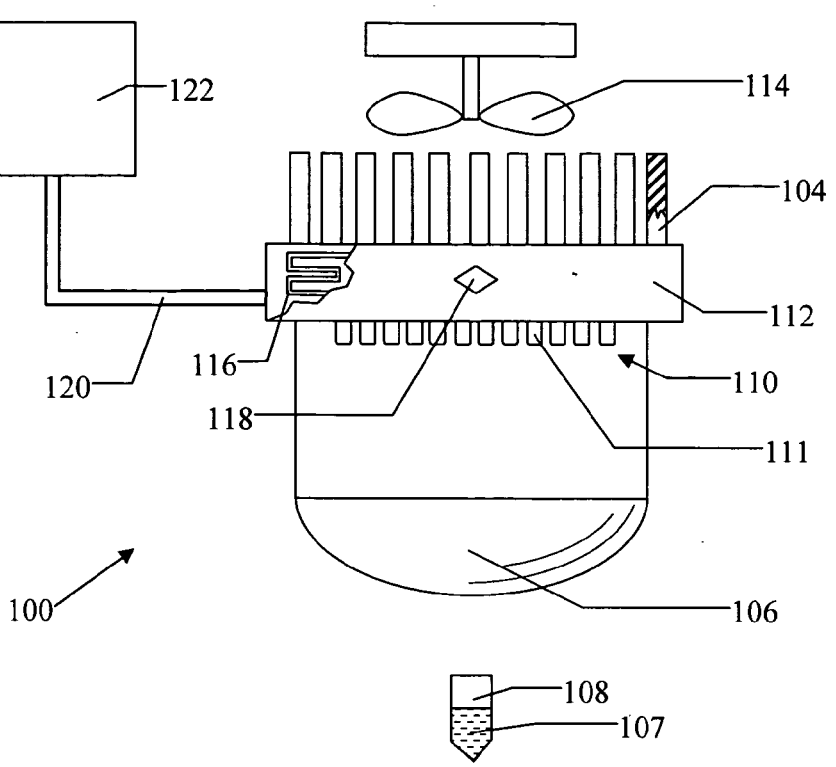


FIG. 1

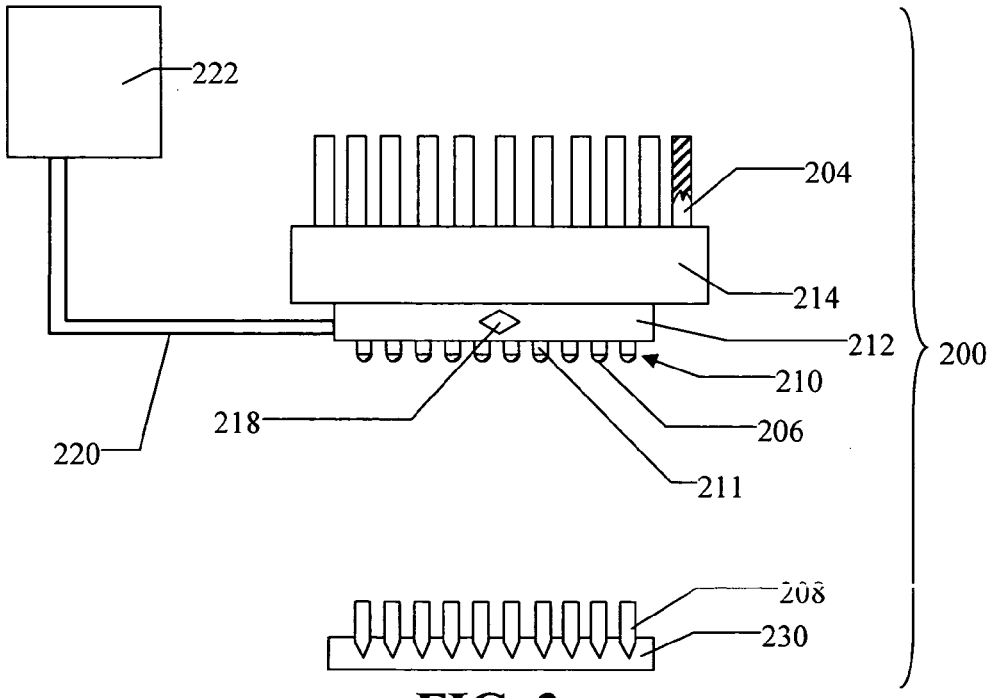


FIG. 2

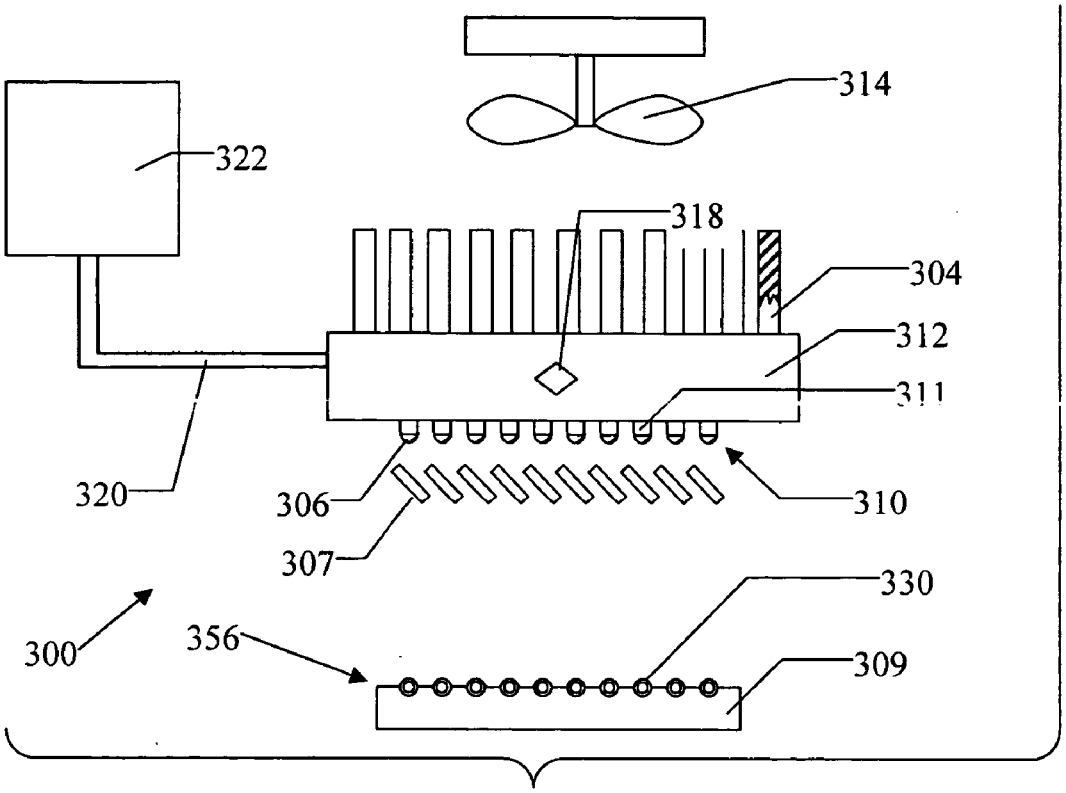


FIG. 3a

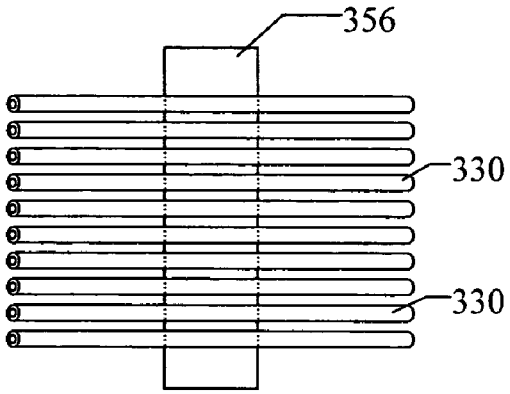


FIG. 3b

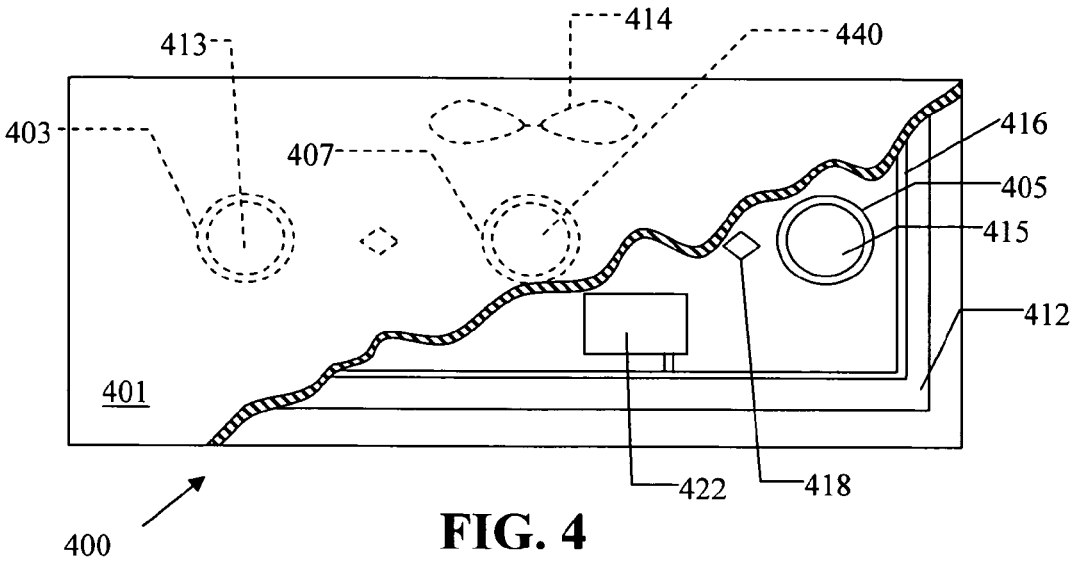


FIG. 4

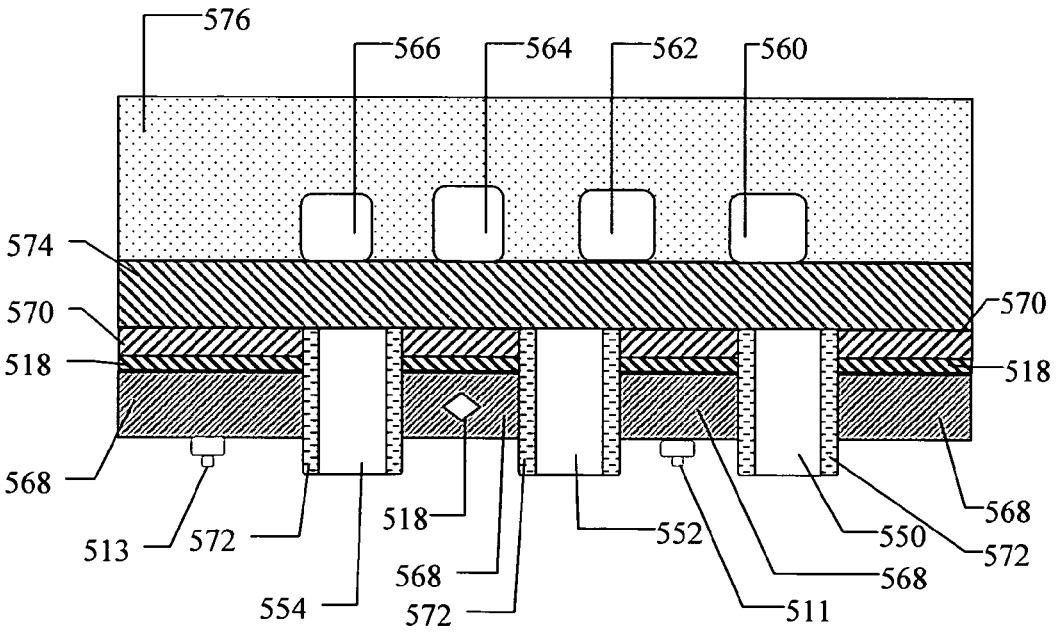


FIG. 5

TEMPERATURE CONTROL FOR LIGHT-EMITTING DIODE STABILIZATION

CROSS-REFERENCE TO RELATED APPLICATION

[0001] The present application is a continuation-in-part of co-pending U.S. patent application Ser. No. 10/440,719, filed May 19, 2003, which in turn is a continuation-in-part of co-pending U.S. patent application Ser. No. 10/216,620, filed Aug. 9, 2002, which in turn is a continuation of co-pending U.S. patent application Ser. No. 09/700,536, filed Nov. 29, 2001, which claims priority to PCT/US99/11088, filed May 17, 1999, which published as publication number WO 99/60381 on Nov. 29, 1999, all of which are incorporated herein in their entireties by reference. Cross-reference is made to co-pending U.S. patent application Ser. No. 10/440,920 entitled "Optical Instrument Including Excitation Source" to Boege et al. (Attorney Docket No. 5010-027-01), co-pending U.S. patent application Ser. No. 10/440,852 entitled "Apparatus And Method For Differentiating Multiple Fluorescence Signals By Excitation Wavelength" to King et al. (Attorney Docket No. 5010-047-01), both filed on May 19, 2003, and to U.S. patent application Ser. No. 10/735,339, filed Dec. 12, 2003, all of which are incorporated herein in their entireties by reference.

FIELD

[0002] The present teachings relate to an optical instrument using excitation beams generated by a light-emitting diode.

BACKGROUND

[0003] Light-Emitting Diodes (LEDs) can be used as an excitation source for optical detection, for example, in fluorescent measurement. There is a need for providing an LED excitation beam source that does not exhibit beam intensity changes and/or spectral shift. A device compatible with nucleotide amplification reactions, detecting such reactions, and capable of processing a relatively large number of amplification reactions is desirable.

SUMMARY

[0004] According to various embodiments, a system is provided that includes one or more light-emitting diode (LED), a temperature sensor, and a temperature regulator. The temperature sensor can be in thermal contact with the LED, can be capable of measuring an operating temperature, and can be capable of generating an operating temperature signal. The temperature regulator can be capable of receiving an operating temperature signal of the LED and regulating the operating temperature based on the operating temperature signal. Herein, it is to be understood that by LED what is meant is at least one LED, and that a group or array of LED's can be included in an "LED" as described herein.

[0005] According to various embodiments, a method for illuminating a reaction region with excitation beams is provided. The method can include providing a system that includes an LED and a reaction region. The method can include generating excitation beams with the LED; directing operating temperature by transferring heat away from and/or into the LED, based on the measured operating temperature. The reaction region can include a sample retained therein.

[0006] According to various embodiments, a method for illuminating a reaction region with excitation beams is provided. The method can include providing a system that includes an LED and a reaction region. The method can include generating excitation beams with the LED; directing excitation beams to the sample; detecting an optical property of the sample to obtain detection data; measuring the operating temperature of the light emitting diode; and adjusting the detection data based on the operating temperature. The adjustment can be made, for example, by shifting the detection data. The shifting of the detection data can include, for example, a shift in intensity, spectra, or both.

[0007] Additional features and advantages of various embodiments will be set forth in part in the description that follows, and in part will be apparent from the description, or can be learned by practice of various embodiments. Other advantages of the various embodiments will be realized and attained by means of the elements and combinations exemplified in the application.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] Various embodiments of the present teachings are exemplified in the accompanying drawings. The teachings are not limited to the embodiments depicted in the drawings, and include equivalent structures and methods as set forth in the following description and as would be known to those of ordinary skill in the art in view of the present teachings. In the drawings:

[0009] **FIG. 1** is a side view in partial cross-section of a system including a heater providing temperature stabilization for an LED array according to various embodiments;

[0010] **FIG. 2** is a view in partial side cross-section of a system including a thermoelectric device providing temperature stabilization for an LED array according to various embodiments;

[0011] **FIG. 3***a* is a side view in partial side cross-section of a system including a fan and cooling fins providing temperature stabilization for an LED array according to various embodiments;

[0012] **FIG. 3***b* is a top plan view of a capillary sample holder according to various embodiments;

[0013] **FIG. 4** is a top view in partial cross-section of a system including a fan and heating element providing temperature stabilization for an LED according to various embodiments; and

[0014] **FIG. 5** is a side view in a partial cross-section of a system providing a strong thermal conductive path according to various embodiments.

[0015] It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only and are intended to provide a further explanation of the various embodiments of the present teachings.

DESCRIPTION OF VARIOUS EMBODIMENTS

DOCKET ALARM

Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts

Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research

With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips

Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS
Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS
Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS
Sync your system to PACER to automate legal marketing.