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Compact device for low-cost, real-time monitoring of blood coagulation

Engineers in Prof. James Harris' laboratory have developed a compact optics and microfluidics device to continuously monitor the hemostatic state of patients undergoing heart surgery, dialysis or other procedures. Current techniques that measure hemostatic state (e.g., coagulation and clotting time) rely on highly trained personnel, use bulky and costly instruments, and only provide snapshots of the patient's blood condition at a specific time. To address those shortcomings, this new device employs Vertical Cavity Surface Emitting Lasers (VCSELs) within a monolithically-integrated arrayable sensing platform to detect fluorescent probes that indicate hemostatic state. The assays do not require any sample prep because they are performed in a microfluidics circuit small enough to attach directly to blood tubes. In addition, the platform could be adapted to operate wirelessly or deliver anti-coagulant drugs as needed. This system could improve patient care by providing portable, low-cost, rapid feedback for early detection of thrombotic events.

Stage of Research
The inventors have built a prototype VCSEL/detector system and developed molecular-specific probes for several coagulation-related blood markers.

Applications

- **Patient monitoring** - continuous real-time monitoring of blood proteins related to coagulation, with end-user applications such as heart surgery or dialysis
- **Drug delivery** - potential for microfluidic system to be adapted to alter dosage of anti-coagulants or other drugs in response to activity or conditions, such as coronary artery thrombosis

Advantages

- **Compact and inexpensive:**
  - on-chip analysis with small, low-cost VCSEL, photodetector and microfluidic chip instead of bulky optics imaging system
  - external circuit small enough to attach to standard blood tubes
  - enables treatment at point-of-care
- **Real-time monitoring** - microfluidic system enables faster analysis than conventional techniques that typically require at least half an hour for sample preparation and processing
- **Compatible with wireless communication**
- **Streamlined data collection and analysis**

Publications

- Methods and Apparatus for Rapid Monitoring of Hemostatic State (U.S. Patent Application, Publication No. 20150374269)

Patents

- Published Application: 20150374269

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