Docket #: S23-460

Method and System for Force Sensors Including Upconverting Nanoparticles in a Polymeric Host

Researchers at Stanford have developed force sensors that can operate on very small physical scales without the need for an external connection or power supply.

Mechanical forces regulate many important biological processes from stem cell differentiation to digestion. Tracking these forces and measuring pressures in an in-vivo or in-vitro microenvironment could help identify the cause of high blood pressure or other health anomalies. However, taking such measurements can be an invasive process, including the need for connective devices with wires and other conduits. The passage of such wires into an organism can create opportunities for infection and they often need to be removed once the measurements are complete. Thus, there is a need in the art for improved force and/or pressure measurement sensors that can operate without the need for an external connection or power supply.

Stage of Development
Research – in vitro

Stage of Research
The inventors have developed force measurement devices that can operate without an external connection or power supply using a force sensor that entails upconverting nanoparticles in a host structure. The force sensors are positioned within an organism at locations where a force or pressure is applied, and the force sensors provide an output that can be used to measure and track forces applied by the organism.

Applications

- Uncovering novel biomarkers of disease that go undetected with traditional chemical, optical and electrical sensing modalities.
- Measuring force between an immune cell and an antigen presenting cell.
- Diagnostics or determining treatment efficacy.

Advantages

- Overcoming disadvantages of other existing mechanosensing tools such as atomic force microscopy or traction force microscopy which are too large and invasive to operate in-vivo, or FRET which is limited in dynamic range and the propensity to rapidly photobleach.
- Can be used to study micronewton scale biological forces because the sensors are small (e.g. less than 20 nm).
- Relatively non-toxic.
- Photostable.
- Exhibit a strong anti-Stokes shift that allows the force sensors to be excited in the near-IR biological window.

Patents

- Published Application: WO2025137477

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