

Handheld Fluorescence Resonance Energy Transfer (FRET)-Aptamer Sensor for Bone Markers

Portable technology evaluates bone loss

Astronauts lose significant bone mass during lengthy space flights. NASA wishes to monitor this bone loss in order to develop nutritional and exercise countermeasures. Operational Technologies Corporation (OpTech) has developed a handheld device that quantifies bone loss in a spacecraft environment. The innovation works by adding fluorescent dyes and quenchers to aptamers to enable pushbutton, one-step bind-and-detect FRET assays that can be freeze-dried, rehydrated with body fluids, and used to quantify bone loss.

In Phase I, OpTech developed several 15-minute specific polyclonal FRET-aptamer assays with low nanogram/milliliter sensitivity. The company also cloned and sequenced 110 bone marker and calcidiol aptamers. During Phase II, OpTech freeze-dried and packaged optimized FRET-aptamer assays for use with a plastic cuvette and body fluid collection system. The assay system is coupled with a handheld, battery-operated fluorometer customized to detect bone markers and calcidiol in urine and serum. Sensitive and accurate (low ng/mL detection with correlation coefficients >0.95), the innovation produces results in 15–30 minutes.

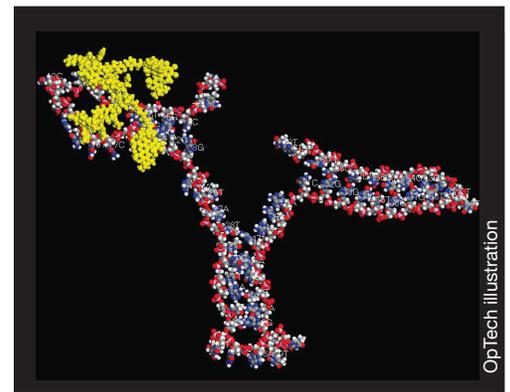
Applications

NASA

- ▶ Astronaut self-monitoring of bone loss and bone loss treatments (e.g., vitamin D augmentation)
- ▶ Monitoring other clinical analytes (e.g., glucose, environmental microbes in water) with development of appropriate FRET assays

Commercial

- ▶ Rapid point-of-care diagnostic system for osteoporosis and its treatment
- ▶ Monitoring system for bone repair following severe fractures and skeletal procedures



Phase II Objectives

- ▶ Synthesize red-region Black Hole Quencher® deoxyribonucleotide triphosphates (dNTPs)
- ▶ Screen all 110 Phase I aptamer sequences for best FRET with bone peptides, hydroxylysine, and 25-hydroxyvitamin D₃
- ▶ Complete three-dimensional modeling of selected aptamer targets
- ▶ Freeze-dry and retest FRET assays in serum and urine samples
- ▶ Coordinate optics and firmware changes for operation in red fluorescence window of serum and urine
- ▶ Develop software package
- ▶ Develop and produce plastic cuvette and body fluid sampling syringe system
- ▶ Integrate system components, including assays, handheld sensor, and laptop computer

Benefits

- ▶ Rapid (15–30 minutes)
- ▶ Easy to use aboard a spacecraft, in a physician's office, or at home with freeze-dried assay reagents
- ▶ Compact (handheld fluorometer)

Firm Contact

Operational Technologies Corporation
John G. Bruno
john.bruno@otcorp.com
4100 NW Loop 410, Suite 230
San Antonio, TX 78229-4253
Phone: 210-731-0015

Proposal Number: 07-2 X12.01-9625