tests after experiencing an acute or emergency medical treatment, such as cardiac arrest, stroke, severe dizziness or unconsciousness, or extreme chest pain.

[0005] To date, there have been some advancements in remote monitoring to begin turning the tide against heart disease. For instance, wearable heart rate monitors are becoming a ubiquitous option for tracking heart rate during exercise or daily activity, monitoring stress and movement levels, tracking sleep habits at night, and in some versions of these wearable devices, testing certain vital signs outside of the clinic, such as ECG to determine singular heart rhythm events, such as a healthy sinus rhythm or risky atrial fibrillation. While these devices are well suited to promote healthier active lifestyles that may contribute to preventing the onset of heart disease or mitigating minor-to-moderate heart disease in the long run, they are ill equipped to identify symptoms or hallmarks of the vast array of heart diseases and incapable of determining any underlying biological or physiological factors at the root of heart disease.

[0006] The challenge for clinicians is to catch heart disease early or manage and monitor diagnosed heart disease post-treatment. Yet, monitoring heart function relies on patient participation and compliance; and existing systems and methods are too time intensive, costly, and under-resourced to be effective.

[0007] There is a need for a new paradigm of sensors deployable in the body of a patient user and capable of monitoring, *in vivo*, mechanical energy associated with physiological phenomena, such as blood flow across a valve of the heart, to characterize overall heart function. There is also a need for adapting this new paradigm of sensors to be worn out-of-body or *ex vivo* to be capable of externally monitoring the internal mechanical energy associated with the physiological phenomena.

SUMMARY

[0007a] According to an aspect of the present disclosure, there is provided an implantable medical device for monitoring mechanical stress from within a host, including: a hermetically sealed housing; and a physical stress sensor encased within the housing and configured to receive an internal mechanical energy signal that emanates from within the host from an internal body structure and to transduce the received internal mechanical energy signal to an electrical signal indicative of a physiological function by the internal body structure, wherein the physical stress sensor is a unimorph piezoelectric sensor having a rigid unimorph piezoelectric structure that does not deflect greater than 10 nm when exposed to the internal

mechanical energy signal, the rigid unimorph piezoelectric structure comprising a piezoelectric transducer coupled to a biocompatible stress absorption material and to an electrode, wherein the biocompatible stress absorption material is operable to receive the internal mechanical energy signal for the unimorph piezoelectric sensor and transfer the internal mechanical energy signal to the piezoelectric transducer, and wherein the electrode is operable to receive the electrical signal transduced by the piezoelectric transducer.

[0007b] According to another aspect of the present disclosure, there is provided a system for in vivo monitoring of internal mechanical energy associated with physiological phenomena originating from an anatomic structure, including: the above implantable medical device; and a data processing system, comprising a processor and a memory, in data communication with the implantable medical device and configured to receive the data from the implantable medical device and process the received data to determine an internal mechanical energy signal parameter associated with a physiological function of the anatomic structure.

[0008] In brief, in one aspect disclosed are devices, systems, and methods for *in vivo* monitoring of internal mechanical stress (also referred to as physical stress) associated with physiological phenomena of an internal body structure, such as the heart, lungs and/or gastrointestinal tract, from within the host. The disclosed devices, systems, and methods include an *in vivo* physical stress sensor implantable in the host's body. The *in vivo* physical stress sensor may be implanted in the host's body without causing damage to the host. For example, the *in vivo* stress sensor may be one or more of hermetically sealed, biocompatible and sterile.

[0009] In brief, in one aspect disclosed are devices, systems, and methods for monitoring of internal mechanical stress associated with physiological phenomena of an internal body structure,