INNOVATION PARTNERSHIPS
UNIVERSITY OF MICHIGAN

Method of Encapsulating Magnetoelastic Resonator and Biasing Element, and Attaching to Metallic Stents

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Life Sciences

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OVERVIEW

A scalable packaging and assembly method integrates miniaturized magnetoelastic sensors with biasing elements into self-expanding metallic stents, enabling wireless, real-time in-stent monitoring for vascular and biliary applications.

- Ultra-thin, biocompatible nitinol-based packages with custom sensor-magnet layers ensure mechanical resilience and fit within next-generation stents.
- Innovative micro-spring and slider attachment mechanisms provide robust stent integration, enabling reliable wireless operation through tissue and fluid environments; the largest immediate market opportunity is post-implant monitoring to preempt stent blockage or failure.

BACKGROUND

Implantable sensors that monitor the function and patency of vascular and biliary stents address a critical unmet need: millions of stent placements annually suffer from late-stage blockages or failures that are often detected too late, resulting in costly emergency intervention and risk to patients. Traditional implantable electronics are bulky, difficult to miniaturize, and prone to corrosion or mechanical failure inside the body. Efforts to wirelessly monitor stents are hampered by the challenge of integrating sensors at stent scale without degrading performance or complicating deployment. The market for “smart stents” is growing rapidly, fueled by trends in personalized healthcare, remote monitoring, and outcome-driven reimbursement models. However, widely adopted solutions will require sensors that are ultra-miniaturized, robustly packaged for harsh physiological environments, reliably powered and read wirelessly, and simple to integrate into clinical workflows.

INNOVATION

This technology delivers a fully miniaturized, hermetically packaged magnetoelastic sensor and biasing magnet directly integrated into a stent-compatible module—without the need for batteries or wired connections. The package’s bi-layer nitinol construction gives it exceptional flexibility and strength, conforming to tight stent geometries while withstanding flexing during and after deployment. Two innovative attachment approaches are included: (1) a micro-spring mechanism that stretches and compresses as the stent length changes, remaining securely anchored even as the stent flexes and moves, and (2) a slider system that accommodates stent expansion with minimal extra bulk. Unlike alternative sensor materials, the magnetoelastic elements are formed from amorphous metal alloys (Metglas), selected for superior mechanical and magnetic properties at miniature scale. A high-performance hybrid coating—combining atomic layer and physical vapor deposited layers—ensures long-term corrosion resistance, enabling device function well beyond the lifespan of the stent. Interrogation coils are redesigned as patient-friendly belts to enable reliable wireless signal detection, even through tissue and body fluids. This system overcomes all key bottlenecks—miniaturization, mechanical protection, robust mounting, wireless range, and biostability—offering a unique pathway to scalable, reliable, and patient-compatible smart stents.

ADDITIONAL INFORMATION

[Placeholder]