Automated Nickel Coating System for Optical Fiber Sensors (FBG and Distributed) for Operation in Ultra-Harsh Environments (+800 °C, Peaks up to 1000 °C, and/or high mechanical Strain)

Summary

Profile type	Company's country	POD reference
Technology offer	**Spain**	**TOES20251212022**
Profile status	**Type of partnership**	**Targeted countries**
PUBLISHED	**Commercial agreement with technical assistance**	**• World**
Contact Person	**Term of validity**	**Last update**
Alessandro BILLI	**12 Dec 2025** **12 Dec 2026**	**12 Dec 2025**

General Information

Short summary

Advanced process for manufacturing fiber optic sensors (FOS) with customizable nickel coatings from a few to several hundred microns. Enables tailored protection for temperature and strain monitoring in ultra-harsh environments (up to 1000 °C, corrosive or high-stress). Validated in energy, naval, and aerospace pilots, it has reached TRL 8 and is ready where conventional FOS fail.

Full description

FRONTIER is an advanced manufacturing process for fiber optic sensors (FOS) that enables the deposition of a tailored nickel coating, with thicknesses ranging from tens to hundreds of microns, adaptable to the specific demands of each application—unlike commercial solutions that typically use fixed 50 µm coatings of Cu, Al, or Au. This robust coating dramatically enhances mechanical integrity, thermal stability, and corrosion resistance, enabling accurate and simultaneous monitoring of temperature and strain in environments with sustained temperatures above 800 °C (peaks up to 1000 °C) and aggressive chemical or mechanical stress. Conventional FOS fail under these conditions due to hydrogen ingress, bonding failures, or material degradation.

Current state-of-the-art solutions do not offer reliable, integrated sensing of both temperature and strain under these extreme conditions, leaving a critical gap in the market. FRONTIER fills this gap with a unique, high-performance

solution that is currently undergoing patenting and is ready for deployment.

The main application fields for FRONTIER include the energy, naval and aerospace where the technology has been successfully validated through pilot projects. FRONTIER has proven particularly effective for high-temperature processes (e.g., biomass and combined-cycle boilers), structural health monitoring in energy storage systems (e.g., CSP plants), and condition monitoring of hard-to-access components (e.g., bearings in naval engines). Its ability to embed sensors directly into metallic components further expands its applicability to areas such as aviation engines, where resistance to extreme temperatures and corrosion is essential. Other promising sectors, where validation is still pending, include the nuclear and metal casting industries.

The desired cooperation is focused on establishing a long-term technology licensing agreement encompassing both the coating process and the equipment used for fiber production, currently under patenting. However, as an intermediate step—based on market feedback—it has been considered to initiate collaboration through the production of small, made-to-order fiber batches over a limited period. This practical phase is enabling international partners and end-users to test the product in real-world applications, fostering mutual understanding and trust. We see this cooperation evolving into a structured, long-term commitment, with clearly defined roles for technology transfer, joint validation activities, and potential scale-up strategies supported by a collaborative framework.

Advantages and innovations

FRONTIER represents a significant technological breakthrough in the monitoring of high-temperature, harsh, and corrosive environments. Traditional FOS technology has been widely used, but it faces a key challenge: the inability to withstand extreme conditions, such as prolonged exposure to temperatures above 800ºC or aggressive industrial environments.
The core innovation lies in AIMEN's development of a nickel-based metallic coating, with a tunable thickness up to hundreds of microns mm—compared to the standard 50 µm in commercial solutions. This robust coating significantly enhances the mechanical strength, thermal stability, and environmental resistance of FOS, enabling them to effectively monitor temperature and strain in ultra-harsh environments, offering the following competitive advantages:

• Higher mechanical stress resistance: FRONTIER's metal-coated FOS are capable of withstanding higher mechanical stresses, in industrial environments, when coupled to structures (via welding or adhesives). Competing solutions with metal coatings up to 50 µm are insufficient, often leading to sudden failures under localized stress.

• Minimized thermal degradationThe FRONTIER technology applies a specially developed nickel coating that effectively shields the silica-based optical fiber from thermal degradation in extreme environments. While SiO_2 is inherently stable at high temperatures, this stability diminishes at the microscale and under intense thermal gradients. Standard commercial coatings are insufficient to withstand temperatures around 800 °C. Studies conducted with the FRONTIER technology have demonstrated that a minimum coating thickness of 150 µm is required to ensure reliable and long-term performance under these conditions.

• Endurance of high-temperature embedding processes: FRONTIER's Ni coated FOS endure high-temperature embedding processes, such as TIG or laser welding, which reach temperatures over 1,000°C.

Technical specification or expertise sought

Stage of development

Available for demonstration

Sustainable Development goals

• Goal 11: Sustainable Cities and Communities
• Goal 9: Industry, Innovation and Infrastructure

IPR Status

IPR applied but not yet granted

IPR Notes

Partner Sought

Expected role of the partner

We are looking for a specialty fiber optic sensor manufacturer or technology provider specialized in advanced coating techniques for FOS, targeting applications in harsh environments, such as high temperature (>700 °C) conditions, strain monitoring, or embedded sensing.

Type of partnership

Commercial agreement with technical assistance

Type and size of the partner

- **SME 11-49**
- **Big company**
- **SME 50 - 249**

Dissemination

Technology keywords

- **01002004 - Embedded Systems and Real Time Systems**
- **04001002 - Heat transport and supply, district heating**
- **02002002 - Coatings**
- **04001001 - Heat storage**

Market keywords

- **06010003 - Energy for Industry**
- **03006 - Fibre Optics**
- **06008 - Energy Storage**
- **06003006 - Combined heat and power (co-generation)**

Targeted countries

- **World**

Sector groups involved

- **Energy-Intensive Industries - Materials**
- **Renewable Energy**
- **Electronics**
- **Maritime Industries and Services**
- **Aerospace and Defence**

Media

PDF documents

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