Cryogenic response of Distributed Optical Fiber Sensor coatings under cyclic thermal shocks

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The development of Distributed Optical Fiber Sensors (DOFS) for cryogenic environments is crucial for accurate measurements under extreme thermal conditions, such as those found in fusion power plants. Such as High-Temperature-Superconductors (HTS), these are considered enabling technology for the future high magnetic field and compact nuclear fusion reactors. The possibility to use FOS technology as diagnostic for HTS attracts the interest of the scientific community. However, the sensor response is linked to the thermo-mechanical behavior of their external coatings.

This preliminary study examines the sensor response changes as a function of coating type by subjecting- for several times- different coated-optical fibers in liquid nitrogen (LN_2). Monitoring was performed using the ODISI interrogation system (Luna Technologies); concurrently, a pre- and post-cycle morphological investigations were done, in order to detect potential structural alterations or surface defects. The results show coating-specific behaviors under thermal excursions. The morphological analysis shows no structural compromise or damage. Other tests are required to define the operational limits and long-term stability of these coated-fibers in cryogenic applications.

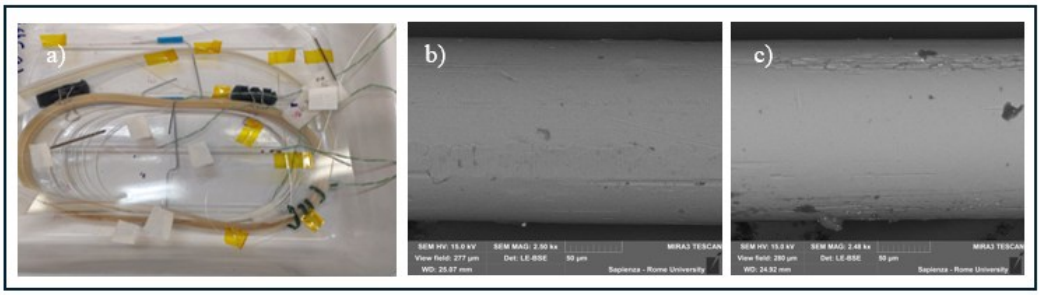

Figure 1. a) experimental set up; b) Al-coated fiber pre-immersion; c) Al-coated fiber post-immersion