Feasibility Study of Visual and Measurement Technology for Innovative Approach<Fujikura Ltd.>

Purpose and Goal

Study the development for the practical use of the visual equipment usable for the alternative method for fuel debris retrieval to be conducted under the high dose radiation environment. In this subsidized project, since imaging fiber using the pure silica glass is characterized in high radiation resistant, we will conduct a basic study to develop fiber scope which has 2MGy or more high radiation durability required for fuel debris retrieval by applying the manufacturing technology of silica glass optical fiber, and a design verification for the fiber array type scan imaging system with high resolution / high flexibility which compensate the disadvantage of silica glass imaging fiber.

Overview and Feature

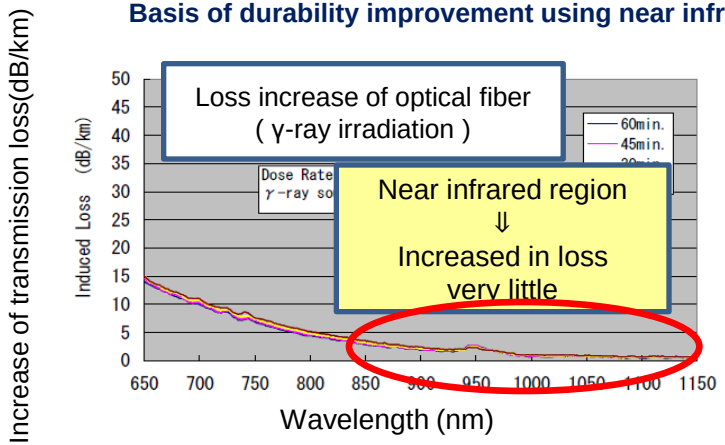
Study the three possibilities to realize the visual technology under the high dose radiation environment.

A. Study the irradiation durability through the observation in the near infrared reigion using high OH radical -containing silica glass imaging fiber
B. Study the development of fluorine-doped pure silica glass core/imaging fiber and its radiation resistant characteristics
C. Study the high resolution and high flexibility imaging system using optical fiber array.

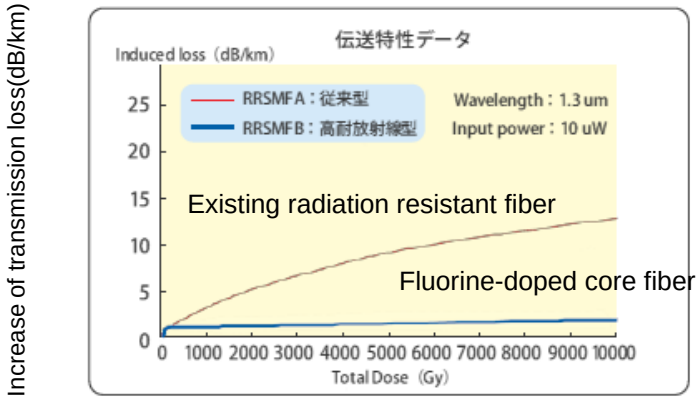
・Theme A：Silica glass fiber has high radiation resistant, and especially in the near infrared region, its transmission characteristics is not sensitive to irradiation. Through the observation in the near-infrared region utilizing this characteristics, we are aiming at developing the high durability fiber scope which can endure the irradiation of 2MGy or more.

・Theme B：It has been found that the radiation resistant characteristics of optical fiber is largely improved by adding a very small quantity of fluorine to the silica glass. As an optical communication fiber, an optical fiber to transmit wave of 1.3um-1.55um has been achieved, and we apply this technology to the imaging fiber, and realize the radiation resistant fiber scope within the visible range.

Basis of durability improvement using near infrared



Radiation characteristics of fluorine-doped core fiber (1.3um)



Output so far/Output expected

In this project, we conduct γ-ray irradiation test for the imaging fiber, observation for the transmitted image and measurement for the transmission characteristics, and we evaluate its durability against the irradiation so as to study feasibility of fiber scope for the cumulative dose level of 2MGy.
1) Determined irradiation test requirements and selected irradiation test facilities.
Irradiation test is conducted for dose rate 10kGy/hr up to 2MGy as cumulative dose.
It is required to conduct the evaluation of transmitted image of imaging fiber during the γ-ray irradiation and transmission characteristics.
We selected facilities for the irradiation test based on the above requirements and will conduct the test from mid-Feb.
2) Designed imaging fiber for irradiation test and conducted trial production. Length of imaging fiber for test is required to be 100m long including the 20m for irradiation part under the irradiation test environment. Also, imaging fiber is required to be bundled into small diameter of R100mm to obtain dose rate of 10kGy/hr. Based on these requirements, we designed the fiber used for the irradiation test this time for 6000 pixels and implemented trial production.
3) Now preparing the equipment for irradiation test. We are promoting selection and preparation for each piece of equipment for image observation and transmission test using prototype imaging fiber mentioned above.
Followings are samples of transmitted image using imaging fiber under the trial production.

A. High OH radical -containing silica glass imaging fiber (for near infrared observation)

B. Fluorine-doped core imaging fiber (for visual observation)

○Evaluate the performance and the feasibility of the fiber scope for 2MGy irradiation through the evaluation results for γ-ray irradiation conducted on Feb.

Overall Schedule

Item	Nov.	Dec.	Jan. 2015	Feb.	Mar
Imaging fiber design for testing	→				
Prototype development for testing imaging fiber		→	→		
Design/prototype for testing optical element	→	→	→		
Establish operating procedures for evaluation test		→			
Selection/preparation for equipment for evaluation test		→	→		
Irradiation test, measurement and evaluation				→	
Evaluation and study					→