# A composite-type optical fiberscope system with hybrid functions of diagnosis and medical treatment

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# 1. Introduction

A composite-type optical fiberscope which has furthered technical development in Japan Atomic Energy Agency (JAEA) is a special fiberscope which can treat both a high energy laser light and image information [1]. This composite type optical fiberscope was born as a specific tool which is useful for the maintenance technical development in a nuclear fusion reactor and a large-sized nuclear installation [2][3]. This fiberscope is useful in narrow parts, such as a fuel bundle of reactor internal, and piping of a heat exchanger. Since this technology has high flexibility, at the present, the application to the medical field is under promotion as diagnostic and treatment equipment. In this report, the basic structure of a composite-type optical fiberscope and the example of the medical application are introduced.

# 2. Composite-type optical fiberscope

The composition of equipment and basic structure of the composite-type optical fiberscope are shown in Fig. 1.



Fig.1 Composite-type optical fiberscope system

The developed system is comprised of a composite-type optical fiberscope, laser source, coupling device, light source for illumination, and TV monitor (Fig. 1(a)). The composite-type optical fiberscope can transmit laser energy and images for observation in parallel. The diameter of the cautery laser fiber is 0.1 mm, and the imaging fibers are located around the laser fiber. By changing the wavelength and the irradiation method (continuous wave (CW) or pulse wave (PW)) of the laser light transmitted by the laser fiber, a variety of medical treatments is possible.

# 3. Medical application

First of all, authors considered application for fetal surgery medical treatment. Although the advent of minimally invasive fetal endoscopic laser treatment (fetoscopic laser photocoagulation, FLPC) has strikingly improved the natural history of fetuses with twin-twin transfusion syndrome (TTTS), this underwater unique surgery is still technically demanding depending on placental location, position of floating twins, gestational age, and fetomaternal obstetrical conditions. In an attempt to resolve most of these difficulties associated with FLPC, we developed a composite-type optical fiberscope that enables transmission of laser light and endoscopic images concurrently [4]-[7].

Now, this equipment is advancing study which aimed at utilization in some medical fields. The effort for endometrium cancer medical treatment is also one of them [8]. Treatment for cancer of uterine body is basically a hysterectomy (the surgical removal of the uterus), and it causes infertility (inability to become pregnant) after the surgery. Considering recent tendencies of "aging society with fewer children" and "late marriage", a new non-hysterectomized treatment for early stage cancer is essential to maintain fertility. In the general process of diagnosis and treatment, uterine cervix has to be opened. A 1.0mm diameter composite-type optical fiberscope can go through the cervix without any dilator, which reduces burden of cure. Also, exploiting the feature that the fiberscope transmits multi wavelength laser beams, we are making investment toward a new hybrid diagnosis and treatment. This technique is expected to allow laser ablation, PDD (Photodynamic Diagnosis) and PDT (Photodynamic Therapy) in 1 fiberscope.

### 4. Conclusions

Minimally invasive techniques such as endoscopy and robotic surgery have been developed with recent progress of medical engineering. These treatments may reduce the burden of care and abridge hospitalization, which tends to enhance QOL (Quality of Life). Our newly developed "composite-type optical fiberscope" is characteristic of transmitting image and laser in parallel. This fiberscope can be used to various regions in body, and that may contribute as a big benefit to the growing minimally invasive surgery market.

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