Chemical Sensing for Liquid-Property by Using A Hetero-Core Optic Fiber

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A new type of fiber optic sensor has been developed for liquid sensing using a hetero-core structure. In contrast to a conventional technique such as an unclad optical fiber which showed the fabrication difficulty, hetero-core fiber optic sensor can be characterized by the simplicity in their fabricated structure. The sensor utilizes a short-length of approximately 30 mm in length, different core-size fiber insertion in a fiber as a transmission line. In this research, a 50-3-50 type hetero-core fiber has been investigated which consists of a multi mode fiber with a 50-μm core diameter as a transmission line, and a hetero-core portion which is an inserted single-mode fiber with a 3-μm core diameter. Light of multi mode propagation in the transmission line spreads out toward the cladding region at the splice junction with producing cladding modes at the hetero-core region. Such cladding modes are subjected to influences by refractive index and absorption properties of the outer cladding condition with leading to the corresponding propagation loss. An experimental setup measured the change of spectra for liquid adhesion around the hetero-core portion with a curvature radius of 30 mm. Visible spectra were measured with an optical spectrum analyzer as a detector and with a white light source with the wavelength region 400-1800nm as a light source. Chromoxane cyanine R(CCR) dye solutions has also showed a notable change in the absorption spectrum with the variation of HNO_3 concentrations. Additionally, the sensor response exhibits differences in the spectra of glycerin-water solutions for the concentration range of 60-90% compared with water, as indicated in Fig.1. The increase of loss reflects the increasing of the refractive index with increasing concentration of glycerin solution. This becomes prominent when the glycerin concentration comes to over 85%. This results show that hetero-core optic fibers can detect the change of cladding modes coupled with the concentration of glycerin. These experiments shows the feasibility of the developed hetero-core sensor as a chemical sensor for liquid characterization.

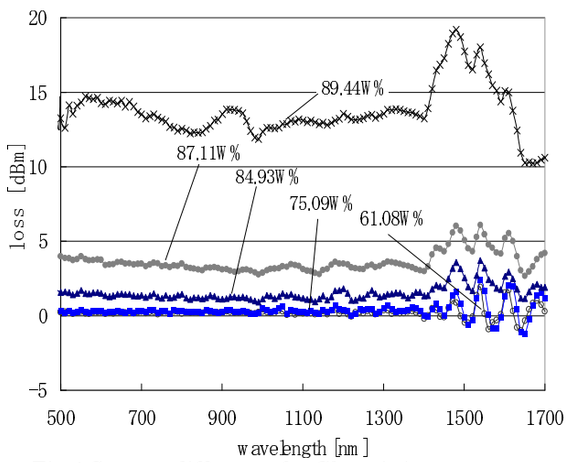

Fig.1 Spectra difference for Glycerin/water solutions with respect to water without Glycerin.