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Mechanical vibration characteristics of hetero-core fiber optic sensor built in at both clamped ends with bending

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Vibration monitoring for early detection of failures have been proposed in various industrial fields. Conventional vibration monitoring techniques have been widely used based on capacitive or piezoelectric accelerometers. However, the vibration sensors for the industrial applications are preferred to be unaffected from the electro-magnetic interference (EMI) noise. On the other hands, a fiber optic sensor is superior to the conventional electric sensors for the vibration monitoring. This is because that it is not necessary to supply the power at the sensor itself, and they are resistant to corrosion and fatigue and immune to electromagnetic interference. We have been developing hetero-core fiber optic sensors, which are made of a stable single-mode (SM) fiber and can detect bending curvature changes in optical loss change. It is also insensitive to temperature changes of the sensor portion because the length of the sensing region is as long as a few millimeters so as not to be affected from the silica thermal expansion. In previous study, we presented characteristics of a newly-developed hetero-core fiber mechanical vibration sensor for simple fault diagnosis of the machine. The proposed technique with high robustness under the harsh environment has possibility in achieving a simple and real-time fault diagnosis system. In this paper, since the hetero-core fiber optic sensor sharply induces the optical loss change to curvature change of the fiber, we arranged the construction of the hetero-core fiber to be more strongly bended fixed at the two ends by a tip arranged at the bending direction as shown in Fig. 1(a). The uniform cylindrical fiber plays a role as a beam due to its rigidity from a silica glass and acrylate coating. As shown in Fig. 1(b), vibration characteristics of the proposed configuration indicate harmonic mode of vibration for the two rigid ends and the tip as a single support. The natural frequency of the fiber is tunable with the length between two fixed ends.

Biography

Michiko Nishiyama received B.S. degree from Ochanomizu University, Tokyo, Japan, in physics in 2000. She worked in Nikon as designing an optical lens system from 2000 to 2003. She received M.E. and Ph.D degrees from Soka University in information systems science in 2005 and 2008. She worked on development of optical fiber sensors, as an assistant professor of Soka University from 2008 to 2011. She was a research associate at JAXA from 2011 to 2014 and currently a lecturer at Soka University since she re-joined in April 2014.

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