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This Week's Citation Classic

Horiguchi M & Osanai H. Spectral losses of low-OH-content optical fibres. *Electron. Lett.* **12**:310-12, 1976.
[Ibaraki Electrical Communication Lab., Nippon Telegraph and Telephone Public Corp., Ibaraki, and Fujikura Cable Works, Ltd., Tokyo, Japan]

This paper describes a proposal for a new optical communication system with very long repeater spacing, using a long-wavelength band in a silica-based optical fiber waveguide. An intrinsic ultra-low-loss spectral region with a 0.47 dB/km minimum loss has been discovered as well as the realization of very low-OH-content optical fibers. [Based on the citation record, 1961-80, the *SCI*® indicates that this paper has been cited in over 205 publications since 1976, making it the most-cited paper published by this journal.]

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"The work leading to this paper was done nearly six years ago at the Ibaraki Electrical Communication Laboratory of Nippon Telegraph and Telephone Public Corporation, Japan. Since 1971, I have studied optical fiber characterization. In 1975, it was widely recognized that silica fiber has two low-loss regions ('windows') in the 0.85 μm and 1.05 μm wavelength bands. The 0.85 μm wavelength band was an especially promising candidate as a practical wavelength in future optical communication systems because the GaAs injection laser had been developed as a suitable light source.

"At this stage, I was very interested in silica fiber transmission characteristics in the longer wavelengths of more than 1.1 μm, because Payne and Gambling[1] had reported that silica glass material dispersion falls to zero in the vicinity of a 1.27 μm wavelength. In the fall of 1975, I succeeded in developing an automated spectral loss measurement system which covers the 0.4-2.5 μm wide spectral range. At the same time, I studied the loss mechanism in silica fiber, and soon found that the silica fiber transmission loss should be minimal at longer wavelengths, 1.1-1.8 μm, if the OH-ion content in the glass could be reduced to less than 100 ppb.

"In early February 1976, Hiroshi Osanai of the Fujikura Cable Works, Ltd., who was a co-researcher in this study, succeeded in making very low-OH-content optical fibers, using an advanced MCVD method. He saw that, on rare occasions, a beautiful loss spectrum was observed in the 0.6-1.1 μm spectral range; the absorption peak at 0.945 μm due to OH impurity had been completely eliminated.

"On March 27, 1976, I evaluated the transmission loss characteristics of the optical fiber in the long-wavelength band. To obtain the intrinsic loss spectrum in silica fiber, a very small launching numerical aperture, as small as 0.05, had been selected. I found that the loss spectrum has a 'V' shape with a minimum loss of 0.47 dB/km at 1.2 μm, where the material dispersion gradually falls to zero. On the basis of this result, we proposed an optical communication system using the above low-loss and low-dispersion 'window.' From this study, a new term, 'the long-wavelength band,' was created.

"Why has this paper been cited relatively often? I can think of four probable reasons: (1) This discovery disproved the established theory that minimum loss is attained at two points—0.85 μm and 1.05 μm wavelengths. (2) The attained minimum loss is far lower than the past lowest record of 1.1 dB/km, reported in 1974 by Bell Telephone Laboratories.[2] (The minimum loss so far observed is 0.20 dB/km, attained by Ibaraki-ECL in 1979.[3]) (3) This study has stimulated new research concerning the long-wavelength band. (4) Taking advantage of this study, the silica fiber loss mechanism in the long-wavelength band has been clarified.[4,5]

"The authors received the 1976 *Electronics Letters* Premium from IEE of the United Kingdom, the 1977 Achievement Award from IECE of Japan, and the 1978 Science and Technology Agency President's Award from the Japanese government for this study."

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3. **Miya T, Terunuma Y, Hosaka T & Miyashita T.** An ultimately low-loss single-mode fiber at 1.55 μm. *Electron. Lett.* **15**:106-8, 1979.
4. **Osanai H, Shioda T, Moriyama T, Araki S, Horiguchi M, Izawa T & Takata H.** Effects of dopants on transmission loss of low-OH-content optical fibers. *Electron. Lett.* **12**:549-50, 1976.
5. **Horiguchi M & Takata H.** Transmission-loss characteristics of low-OH-content optical fibers. *Rev. Elec. Commun. Lab. Tokyo* **27**:226-35, 1979.