Research Journal of Optics and Photonics

Editorial

A SCITECHNOL JOURNAL

Significant suppression of Rayleigh scattering loss in silica glass formed by the compression of its melted phase

Editorial

Silica glass had long and intensively been studied due to its technological interest in manufacturing higher-performance optical fi bers. Recently, silica glass formed at high temperature and pressure is attracting much attention due to its physical properties which cannot be obtained by compression at room temperature. For example, the intermediate-range order structure of silica glass which was hot-compressed at several GPa around the glass-transition temperature (Tg ~1400K) was reported to be more homogeneous and is completely diff erent from that of silica glass compressed at room temperature, even though their densities were similar. Th e threshold pressure to trigger the change seemed to decrease with increasing temperature. We have previously reported that the Rayleigh scattering intensity in silica glass can be explained in terms of the voids in the glass behaving as scattering particles. Here, the expression of "void" stands for sub-nanometer size structural empty space, not bubbles. Th e void size was observed to decrease as the fi ctive temperature, Tf (temperature at which the glass network structure is "frozen"), decreased, by using positron annihilation lifetime spectroscopy. Th e decrease of the void size was found to suppress local density fl uctuations which, in turn, led to less intense light scattering. Th us, a decrease of the Rayleigh scattering intensity was expected if a reduction of the void size can be achieved. For industrial usage, pressures of less than 200MPa is desirable since samples of up to one-meter size are obtainable in a ready-made hot isostatic pressure (HIP) machine. Th erefore, we investigated the Rayleigh scattering intensity of hot-compressed silica glass using HIP under its melted phase. As a result, the optical transport properties of the silica glass was largely improved by the process. The lowest Rayleigh scattering loss was obtained for the glass held at 200MPa and 2073K for 4h. Th e observed loss corresponds to 0.07dB/Km at 1.55 m, which is about half of the loss in conventional silica glass fi ber. Th e decrease in the loss was well explained in terms of the decrease in the size of the sub-nanometer-sized structural voids. Due to the compressive stress, the refractive index increased simultaneously with the decrease in the void size and the scattering intensity. Th is is very favorable for fibercore media, where high transparency and strong confi nement of light are desired. It is not possible to otherwise get such glass homogeneity (corresponding to such a low Tf) and reduce the Rayleigh loss simply by thermal engineering at standard atmospheric pressure.