Controlling Voids in Silica Glass for Ultralow Optical Scattering Loss

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Reducing the loss of the optical communication fiber remains a challenge. The core material of the fiber is silica glass. In silica glass, Rayleigh scattering loss accounts for more than 80% of the transmission loss. The other components such as structural mismatch and/or absorption are very small. Therefore, it is important to find a method to suppress Rayleigh scattering. Since Rayleigh scattering is caused by density fluctuations in the silica glass, a method of reducing the density fluctuations by lowering the fictive temperature of the glass has been the primary means of reducing loss. However, since lowering the fictive temperature hit the limit, the research on loss-reduction had been stagnant for almost 40 years.

Recent finding revealed a new method can be applied to reduce the loss further by reduction of void size in silica glass structure using hot compression. I review the findings on the structural void in silica glass and how pressure-quenching worked to reduce optical loss. Together with results of computer simulation, and structural modeling found by high-energy X-ray spectroscopy, the relationship between the homogeneity and the ordering of the silica glass structure with the loss reduction will be discussed.