Raman study of the solid solution of molecular hydrogen in the silica glass

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Solutions of molecular hydrogen and deuterium in silica glass with molar ratios $H_2/\ SiO_2 = 0.6$ and $D_2/\ SiO_2 = 0.63$ were synthesized at a hydrogen pressure of 7.5 GPa and T = 250 °C. A detailed study of these solutions by Raman spectroscopy revealed a significant effect of dissolved hydrogen and deuterium on the phonon spectrum of the silica glass matrix. The rotational and stretching modes of the hydrogen molecule appear in addition to the redistributed modes of silica glass. The same changes occur in the spectrum of silica glass deuteride, while the frequencies of the rotational and stretching modes of dissolved deuterium change in accordance with the isotopic effect in a diatomic molecule. The frequencies of the rotational and stretching modes of hydrogen are shifted, respectively, to the lower and higher frequencies in comparison with the frequencies in the gas phase. Such a strong mutual change in the phonon spectra of the silica matrix and hydrogen indicates the formation of hydrides of a new type, belonging to the class of inclusion compounds.