

Water Decomposition and Hydrogen Penetration into Phosphate Glass

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Abstract

The phosphate glass (33NaO-0.5-10BaO-10WO₃-20NbO₂.5-27PO₂.5) was prepared by the conventional (melting-quenching) method. Obtained colorless transparent glass changed to deep blue by heating at 400-500C in wet ambient. This color change was due to the reduction of tungsten ion (W(6+) to W(5+)) by the hydrogen penetration. When the glass was heated in D₂O or H₂(18)O ambient, the D penetrated into the glass while the (18)O presented on the surface only, which was suggested from the desorption gas analysis using the mass spectrometer. This result indicates that the water vapor decomposes on the surface of the glass and hydrogen penetrates into the glass. The electrical conductivity increased by the penetration of hydrogen (from 3x10⁽⁻⁷⁾ Scm⁽⁻¹⁾ to 5x10⁽⁻⁵⁾ Scm⁽⁻¹⁾ at 400C) and the ionic (proton) contribution to the total conduction was over 80%. The diffusion coefficient of hydrogen estimated from a profile of the color change was 10⁽⁻⁶⁾ cm⁽²⁾/s at 500C, which is compatible to the diffusion of hydrogen molecule in the vycor glass or helium molecule in the quartz glass. While the diffusion coefficient estimated from -OH concentration profile measured by the microscopic IR spectrometer was 10⁽⁻⁹⁾ cm⁽²⁾/s at 500C. Though these results suggests that two paths for the penetration of hydrogen present in the glass, the detailed process has not clarified yet.