Viscosity Measurements of Fe-FeS Melts under High Pressures

Ken-ichi Funakoshi, Akifumi Nozawa, *Japan Synchrotron Radiation Research Institute, SPring-8, Hyogo, Japan*. E-mail: funakosi@spring8.or.jp

The Fe-FeS melt is the important Earth's outer core material and its viscosity has been thought to be very low under high pressure and high temperature. Recent measurements of the Fe-FeS melt have showed the low viscosity values (~ 10^{-2} Pa-s), however, the accuracies are not so good for determining the viscosity values. An x-ray radiography technique with synchrotron radiation is very useful for the falling sphere viscosity measurement, because it enables us in situ observation of the sinking process and determination of the reliable viscosity coefficient.

We measured the viscosities of Fe-FeS ($Fe_{73}S_{27}$, $Fe_{80}S_{20}$, $Fe_{90}S_{10}$) melts, combining the falling sphere method with the large volume press at the SPring-8. Precise viscosities have been obtained up to 9 GPa using Stoke's law. The pressure dependences of the viscosities are very small, however, the viscosities slightly increase with increasing pressures. The activation energies and the activation volumes have been determined from the dependences on pressure and temperature of the viscosities. The viscosities of the Earth's outer core have been calculated using the activation energies and the activation volumes of $Fe_{90}S_{10}$. The calculated viscosities of the Earth's outer core are similar to those of pure Fe melt [1]. These results imply that the effect of S content in the Earth's outer core may not be so strong.

[1] Alfe D., Kresse G., Gillan M. J., *Phys. Rev.* B, 2000, **61**, 132.

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