Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

SIT004-P10 会場:コンベンションホール 時間:5 月 26 日 14:00-16:30

Electrical conductivity measurements of hydrous minerals under high pressure
Electrical conductivity measurements of hydrous minerals under high pressure

Xinzhuan Guo[1*], Takashi Yoshino[1], Takuo Okuchi[1], Ikuo Katayama[2], Daisuke Yamazaki[1]
Xinzhuan Guo[1*], Takashi Yoshino[1], Takuo Okuchi[1], Ikuo Katayama[2], Daisuke Yamazaki[1]

[1]ISEI, Okayama University, [2]Hiroshima University
[1]ISEI, Okayama University, [2]Hiroshima University

The electrical conductivity measurements of hydrous minerals (including natural talc rocks and serpentinites, synthesized $Mg(OH)_2$ and $Mg(OD)_2$, and synthesized dense hydrous magnesium silicates) were conducted using an impedance analyzer under high pressures generated by a 1000-ton Kawai- type multi-anvil high pressure apparatus. The electrical conductivity anisotropy of deformed natural talc rocks and serpentinites was investigated in the frequency range of 10^{-3}-10^{6} Hz and temperature range of 500-1000 K along three directions: the direction parallel to lineation of oriented minerals (X direction), the direction perpendicular to lineation on the foliation plane (Y direction), and the direction perpendicular to the foliation (Z direction) at 3 GPa. The electrical conductivities of $Mg(OH)_2$, $Mg(OD)_2$ and phase A polycrystals were measured in the frequency range of 10^{-1}-10^{6} and temperature range of 500- 750 K at 3 GPa, 3 GPa and 10 GPa, respectively. For talc rocks and serpentinites, the electrical conductivities parallel to the X direction and the Z direction are the highest and the lowest, respectively. The electrical conductivity anisotropy for the talc rocks is stronger than that for the serpentinite. The electrical conductivity anisotropy of natural deformed talc rocks and serpentinites strongly depends on the crystal structure and orientation of minerals during deformation. The electrical conductivity increases in orders of talc, serpentine, phase A (similar with serpentine), deuterium brucite and hydrogen brucite, indicating the dependence of the electrical conductivity on water contents in the structures. The activation enthalpy of talc rock is the lowest (0.59 eV) in the X direction and the highest (0.68 eV) in the Z direction. The activation enthalpies of the serpentinite in different directions show the consistent value, 0.74 eV, for the experiments using Mo electrodes. In the case of using Ni electrodes, the activation enthalpies are 0.70 eV, 0.66 eV and 0.68 eV for the measurements in X, Y and Z direction respectively. The higher electrical conductivity and the lower activation enthalpy of the serpentine using Ni-NiO buffer are attributed to the higher fO_2 of Ni-NiO buffer. The activation enthalpies of $Mg(OH)_2$, $Mg(OD)_2$ and phase A are 0.86 eV, 0.81 eV and 0.68 eV respectively. Furthermore, grain interior conductivity, grain boundary conductivity and electrode reaction can be recognized from the impedance arcs. Relationship between logarithm of electrical conductivity of grain boundary and reciprocal temperature shows the linear relationship as well as the grain interior conductivity. The total electrical conductivities are reduced by the grain boundary conductivities.

キーワード: Electrical conductivity, Talc rocks, Serpentinites, Brucite, Phase A, Anisotropy
Keywords: Electrical conductivity, Talc rocks, Serpentinites, Brucite, Phase A, Anisotropy