TEMPERATURE DEPENDENCE OF FERRIC IRON AND ELECTRICAL CONDUCTIVITY IN PEROVSKITE

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Recent studies show that the activation enthalpies of 0.6-0.9 eV for either Al-bearing or Al-free perovskite obtained at high temperatures are much higher than those of 0.2-0.5 eV obtained at low temperatures. This difference might be from point defect disequilibrium in perovskite at low temperatures. In order to explore this possibility, we used Mossbauer spectroscopy to determine the temperature dependence of ferric iron in perovskite.The starting materials were San Carlos (Mg0.91Fe0.09)SiO3 orthopyroxene containing 2.9 % Al2O3 by weight and an Al-free synthetic orthopyroxene, (Mg0.915Fe0.085)SiO3. The samples were first pressed to 25 GPa in a multi-anvil apparatus and then heated at 1200, 1600 and 2000 deg C for 120, 60 and 20 minutes, respectively. The results show that the proportion of ferric iron increases with temperature in Al-free perovskite but decreases with temperature in Al-bearing perovskite. If the electrical conductivity of Al-free perovskite is proportional to the proportion of ferric iron in perovskite, the fitting activation enthalpy for perovskite with constant ferric iron at high temperatures is ~0.39 eV, which is consistent with that of 0.39 eV which we measured and those of previous results at low temperatures. The consistent indicates that the increase of ferric iron in Al-free perovskite contributes to the increase of activation enthalpy at high temperatures. Decrease of ferric iron in Al-bearing perovskite with temperature may be relative to decrease of Al2O3 in perovskite.