Developing micro-Raman mass spectrometry for measuring carbon isotopic composition of SiC

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It is known that isotopic compositions of some particles in primitive meteorites deviate remarkably from the solar system. They are called ‘presolar grains’. The presolar grains maintain information before the solar system formed, so they are important research targets for solar system formation and nucleosynthesis process.

Silicon carbide is the presolar material that is researched most extensively because of its high abundance and large particle size. In general, second ion mass spectrometers (SIMS) are used for measurement of trace element and isotope ratio of presolar SiC. However, the analyses with SIMS make pits on samples after the measurements.

In this study, we developed nondestructive and convenient method for measuring carbon isotope ratio of SiC with micro-Raman spectrometry. First of all, we synthesized two kinds of beta-SiC with different isotopic compositions of carbon. Silicon powder and carbon powder which contains 1.1% or 99% ^{13}C were heated in an electric furnace at 1400 degrees C in vacuum. Raman spectra of each SiC were measured with the Raman microscope using Ar laser (514.5 nm) as excitation light.

As a result, remarkable peak shifts were observed between the Raman spectra of two samples. Each peak position corresponds to the calculated value of SiC normal vibration to which the influence of isotope ratio is considered. The present results will be able to be applied to the isotopic measurement of SiC in meteorites.