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Developing micro-Raman mass spectrometry for measuring $^{13}C/^{12}C$ ratio of beta-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 presolar SiC with micro-Raman spectrometry.
First of all, we synthesized beta-SiC with different isotopic compositions of carbon. beta-SiC is one of SiC polytypes, that presolar SiC is classified into. 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. We synthesized six samples with ^{13}C densities from 1.1 to 99%, and confirmed respectively that they were beta-SiC by X-ray powder diffraction.
The Raman spectra of the SiC particles which are 10-100 um in diameter were measured with Raman microscope (Ar laser, 514.5 nm). To avoid heating effect of the laser, we implanted the samples into indium. When analyzed the spectra, frequency of lattice vibration was decided more accurately to fit the asymmetric function to asymmetric spectrum peaks whose cause might be the layer defect of beta-SiC. As a result, the observed frequency harmonized with the calculation value in the 1D diatomic spring model.
In this presentation, we will show results of measuring the carbon isotope ratio of each particle with SIMS, and discussed isotope dependency of the lattice vibration into detail.

Keywords: SiC, Raman Spectroscopy, isotope, SIMS, presolar