

XANES study of titanium in tektites

Ling WANG¹, Akira YOSHIASA¹, Maki OKUBE², Takashi TAKEDA³, Chiya NUMAKO⁴

¹Kumamoto University, GSST, Kumamoto 860-8555, Japan

²Tokyo Institute of Technology, Yokohama, Kanagawa 226-8503, Japan

³National Institute for Material Science, Tsukuba, Ibaraki 305-0044 Japan

⁴The University of Tokushima, Tokushima 770-8502, Japan

Introduction

The tektite is formed at meteoroid impact stage. [1] The concentrations and local structure of each element may have various kinds of information about the asteroid impact. Many studies have focused on the Al, Fe oxidation state and coordination number by X-ray absorption near edge structure (XANES) method, however, fewer studies about the titanium local structure in tektites.

In this study, we measured 6 samples from 2 strewnfields and compared them with titanium compounds. We found three types of tektites were existed, though some of them are from the same strewnfield.

Experimental

The specimens of tektites are from different strewn fields, they are: Hainanite, Indochinite, Philippinite, Australite, Bediasite and Moldavite. The XAFS measurement of Ti local structure was performed with a Si (111) double crystal monochromator at the beam line BL-9C and BL-9A of the Photon Factory in National Laboratory for High Physics (KEK), Tsukuba, Japan. Spectra near Ti K-edge were collected in transmission and fluorescence mode at the room temperature. Analyses of XAFS data were performed by using XAFS93. [2]

Results and Discussion

The Titanium XANES spectra in tektites are shown in Fig.1. These spectra are divided into three groups according to the pre-edge and XANES shape: Group I: Indochinite; Group II: Hainanite-Core, Hainanite-Rim, Australite, Philippinite and Group III: Moldavite-Green. In group I, the percentage of pre-edge is 59%-49%, and at the end of rapid ascent, the density is around 86%. In group II, the percentage of pre-edge is 49%-47%, and at the end of rapid ascent, the density is around 90%. The intensity of pre-edge in Moldavite-Green is about 14%, and at the end of rapid ascent, the height is highest.

The pre-edge peak distribute in tektites, which is shown in Fig.1 is agree with previous studies, the pre-edge feature are found to be have the highest for ⁴⁴Ti and lowest for ⁴⁶Ti model compounds. The height normalized absorbance around the end of the rapid ascent near the threshold display decreasing with the coordination number increased.

The observed XANES spectrum near the Ti K-edge of tektites is compared with reference titanium compounds:

TiO₂ anatase, Fe₂TiO₄ spinel, SrTiO₃ perovskite, MgTiO₃ ilmenite, TiO₂ rutile and Mg₂TiO₄ spinel. And the threshold edges are corresponding to 4979.0eV which match to Ti⁴⁺ in all tektites. Group I and Group II have similar feature in their spectra with TiO₂-SiO₂ glasses [3] except that the moldavite-Green in group III is similar with TiO₂ anatase with six-coordination Ti and feature A (around 4979eV) is always more intense than feature B (around 4991eV).

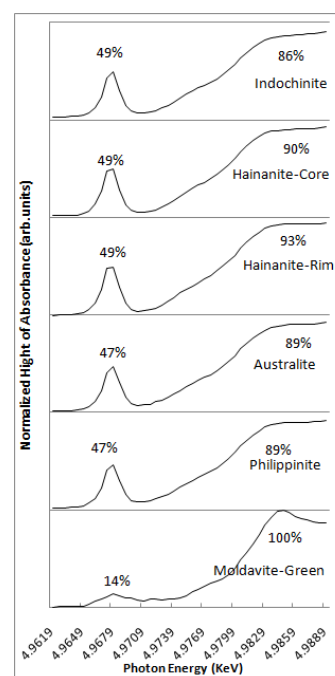


Fig.1 XANES spectra near the Ti K-edge for tektites

As the tektites splashed to the space and travelled in kinds of routes, they went through different temperatures and quenching rates. As a result, there are some difference in the bonding structure of Ti atoms and arrangements of neighbour atoms.

References

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yoshiasa@sci.kumamoto-u.ac.jp