9A/2010G512

Local structure of Ti in tektite by XAFS spectroscopy

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Introduction

The tektite is formed at meteoroid impact stage. Tektites are natural silicate glasses, which can be found at the strewn fields over wide areas. Terrestrial impact theory is widely accepted as its formation. Tektites are among the "driest" rocks, with an average water content of 0.005%. This is very unusual, as most if not all of the craters where tektites may have formed were underwater before impact. It suggests that the tektites were formed under extreme temperature and pressure not normally found on the surface of the Earth. Glass structure (i.e., cation coordination number) is affected by the pressure and temperature conditions existing during the glass formation process. n this study, we will show that the local structure of Ti in tektite should indicate information about the impact event and the following process.

Experimental

The samples we studied comprised six tektites that comes from different strewn field: Hainanite, Indochinite, Philippinite and Australite from Australian strewn field; Bediasite from North American strewn field and Moldavite from European strewn field. We choosed the green and brownish moldavites, black and grey Bediasites, the core and rim of Hainanites. The standards used for XAFS measurement are titanium oxides, such as TiO2 anatase and TiO2 rutile. The XAFS measurement of Ti K-edge was preformed with a Si (111) double crystal monochromator at the beam line BL-9C of the Photon Factory. Analyses of XAFS data were performed by using XAFS93 programs. Details of analysis were given in reference [1].

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 shape: Group I: Indochinite, Bediasite-Black, Moldavite-Brownish; 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 threshold, the density is around 86%. In group II, the percentage of pre-edge is 49%-47%, and at the end of threshold, the density is around 90%. The intensity of pre-edge in Moldavite-Green is about 14%, and at the end of threshold, the density is highest.

In order to obtain the detail local structure information, we figured out the parameter fitting with analytical EXAFS formula [1]. The precursor of tektite is primarily of terrestrial origin, different types of local structure and composition in these tektites are almost same (Table 1), so the chemical fraction of the parent rocks is not important, should be indicating the different physical conditions at impact events. There are some difference in the bonding structure of Ti atoms and arrangements of neighbour atoms. So the local structure of Ti maybe closely related with the temperature, pressure, quenching rate, and size of meteorite and falling melts. The 4-fold, 5-fold and 6-fold titanium is formed under diverse atmosphere [1].

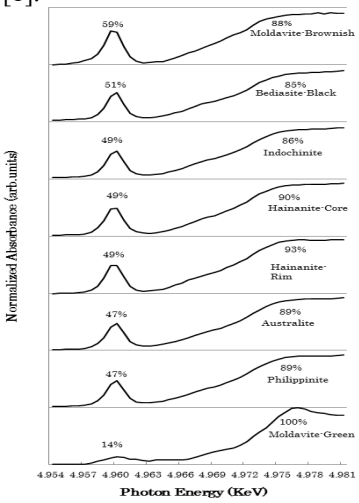

Fig.1. Figure 2 XANES spectra near the Ti K-edge for tektites

Table 1. The structure parameter determined by XAFS.

Sample	σ^2(Å)	CN	Ti-O (Å)	R (%)
Indochinite	0.009(1)	4	1.812(5)	4.3
Moldavite-B	0.020(1)	4	1.817(4)	6.3
Bediasite-B	0.004(1)	4	1.835(3)	0.7
Hainanite-C	0.005(1)	4,5	1.868(4)	0.3
Hainanite-R	0.006(1)	5	1.888(6)	0.1
Australite	0.002(1)	5	1.892(4)	3.5
Bediasite-G	0.015(1)	5	1.896(9)	0.1
Philippinite	0.003(1)	5,6	1.921(5)	2.7
Moldavite-G	0.003(1)	6	2.001(4)	3.5

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