Available online at www.sciencedirect.com

ScienceDirect

Advances in Space Research 56 (2015) 2275–2287

ADVANCES IN SPACE RESEARCH (a COSPAR publication)

www.elsevier.com/locate/asr

Investigation of Comet Wild-2 in terms of effective atomic numbers

İbrahim Han [a,*], Adem Ün [a], Bünyamin Alım [b]

[a] Ağrı İbrahim Çeçen University, Faculty of Arts and Sciences, Department of Physics, 04100, Ağrı, Turkey
[b] Vocational School, Department of Electricity and Energy, Bayburt University, TR-69000, Bayburt, Turkey

Received 18 May 2015; received in revised form 2 August 2015; accepted 22 August 2015
Available online 4 September 2015

Abstract

Effective atomic numbers (Z_{eff}) and effective electron densities (N_{el}) of 69 samples collected from Comet Wild-2 within scope of Stardust mission were determined in the energy range from 1 keV to 100 GeV. The data were individually evaluated for Wild-2 olivines, pyroxene, Fe—Ni sulfide and silicate glass samples to obtain remarkable information about Comet Wild-2. The photon energy and sample composition dependencies of obtained data were investigated. The results show that Z_{eff} and N_{el} values depend strongly on chemical composition and interaction photon energy. The result of present study may be providing new and helpful knowledge about the Comet Wild-2 and ourSolar System.

Keywords: Comet Wild-2; Stardust; Effective atomic number; Effective electron density

1. Introduction

Comet Wild-2is acometnamed afterSwitzerlandastronomerPaul Wild who discovered it on January 6, 1978. Stardust is the name of NASA's space mission studying Comet Wild-2. The primer goal of the Stardust mission is to collect samples from the Comet for laboratory analysis on the Earth. Such particles are called Stardust or pre-solar grains and this is the main reason why the mission was called Stardust (Brownlee, 2004). Stardust Spacecraft which started its travel in January 2004, returned to Earth with both samples collected from Comet Wild-2 and interstellar dust collected during journey.

When a comet is looked at, one can see only a cloud of dust and gas extending from comet. However, if particles and dust from a comet are closely investigated, significant information related to our Solar System can be obtained. Thus, collected samples from Wild-2 have been analyzed by scientists since the return of the Stardust capsule to Earth in January 2006 (Zolensky et al., 2006; Flynn et al., 2006; Hörz et al., 2006; Brownlee et al., 2006; Joswiak et al., 2007, 2009, 2012; Ishii et al., 2008; Schmitz and Brenker, 2008; Leroux et al., 2008; Nakamura et al., 2008a,b; Jacob et al., 2009; Nakamura-Messenger et al., 2011). In this study, effective atomic numbers (Z_{eff}) and effective electron densities (N_{el}) (effective electron density is often called effective electron number and shown as N_{eff}) were determined for 69 different type samples collected by Stardust Spacecraft from Comet Wild-2. The Z_{eff} and N_{el} are useful physical parameters in order to evaluate interactions between photon and samples. Furthermore, these parameters give very exhaustive information for understanding physical and chemical properties of the examined system. They are also used extensively in nuclear and radiation physics, radiation dosimetry, environmental and industrial applications etc. (Manohara et al., 2008, 2009; Han and Demir, 2009; Han et al., 2009; Akkurt, 2009; Kurudirek et al., 2010, 2010; Kaewkhao and Limsuwan, 2010; Cevik et al., 2010;

* Corresponding author. Tel./fax: +90 4722156554.
E-mail address: ibrahimhan25@hotmail.com (İ. Han).

http://dx.doi.org/10.1016/j.asr.2015.08.018
0273-1177/

Table 1
Representative chemical compositions of Wild 2 olivines (normalized oxide wt%).

Track	T 10	T 22		T 26	T 41			T 57			T 61
Name frag	Arinna 5	Aton center 7	Aton rim 7	Ada 1 (TP)	Isis 8	Isis 2	Isis 3	Febo 1 (TP)	Febo 3	Febo 103	Allie 1 (TP)
SiO_2	44.51	35.72	36.79	28.59	42.27	40.38	36.55	41.08	41.00	39.60	42.70
Al_2O_3	0.20	0.15	0.25	0.50	0.34	0.08	0.16	0.11	0.17	b.d.	0.41
Cr_2O_3	0.71	0.10	0.14	0.27	0.26	0.44	b.d.	0.34	0.41	0.15	0.07
FeO	1.19	28.02	17.73	62.23	0.24	7.76	27.02	3.31	2.98	15.29	1.08
MnO	0.08	0.89	0.76	6.58	0.64	0.34	0.72	1.09	0.78	0.51	0.10
MgO	53.03	34.17	43.52	1.29	56.18	50.74	34.76	53.92	54.62	44.26	55.64
CaO	0.27	0.31	0.27	0.03	0.04	0.26	0.17	0.15	0.05	0.19	b.d.
P_2O_5	b.d.	b.d.	0.54	0.52	0.04	b.d.	0.23	b.d.	b.d.	b.d.	b.d.
	T 77						T 80	T 130	T 141		
	Puki 1 (TP)	Puki 2	Puki 3	Puki 4	Puki 5	Puki 50	Tule 3	Bidi 1 (TP)	Coki 1 (TP)	Coki 3	Coki 11
SiO_2	37.36	37.26	33.90	36.93	37.93	41.54	32.18	42.93	40.33	36.76	42.43
Al_2O_3	0.15	0.34	b.d.	b.d.	0.06	0.12	b.d.	0.20	0.18	0.57	b.d.
Cr_2O_3	0.08	0.27	0.14	0.18	0.02	0.31	0.27	0.53	b.d.	b.d.	0.24
FeO	27.47	32.49	37.61	33.86	29.22	0.18	46.96	1.88	18.73	16.19	0.14
MnO	0.42	0.80	0.64	0.73	0.66	0.46	0.71	0.17	0.62	0.53	0.50
MgO	34.13	28.48	26.93	27.89	31.45	57.37	19.55	54.07	39.97	45.90	56.67
CaO	0.21	0.36	0.61	0.42	0.26	0.03	0.32	0.23	0.17	0.04	0.03
P_2O_5	b.d.	b.d.	b.d.	b.d.	0.29	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.