2842
doi:10.1017/S1431927620022965
Microsc. Microanal. 26 (Suppl 2), 2020

Scanning Electron Microscopy Analysis of High Purity Libyan Desert Sandstone Silica Sand

Nuri A. Zreiba and Reda M. Dweiby

Materials and Metallurgical Eng. Dept, University of Tripoli, Tripoli, Tripoli, Libya

(E-mail: nurizreiba@yahoo.com, reda281220012@yahoo.com)

ABSTRACT - High purity silica sand is an important commodity used for the processing of photovoltaic silicon for solar cells. The sand must meet very closely defined specifications related to its impurity content and particle size distribution. Scanning Electron Microscopy (SEM) is one of essential techniques used to characterize trace amounts of impurities and their distribution within individual sand particles. The objective of this work is to characterize the impurities present in high purity sandstone silica sand withdrawn from a deposit site located in southern part of Libyan Desert called Al-Shibat using imaging and analytical capabilities of SEM.

Keywords: Silica; SEM; impurities

Introduction

SEM when equipped with modern nanometer resolution imaging and analytical capabilities can be a powerful tool for characterizing particulate materials [1]. In SEM, BSE and EDAX can be used to differentiate among minerals like quartz, feldspars, clay minerals, heavy minerals, pyrite, carbonate and silica cements in sandstones. As far as the knowledge of the authors, almost no previous application of the SEM-EDAX analysis was done to characterize the distribution of impurities in high purity Libyan Desert sand. The only work done using Backscattered Electron imaging (BSE) [2] was that of Algerian desert quartz sand which probably passed by sediment's history as Libyan Desert sand. In case of high purity Libyan sand extracted from Al-Shibat, previous chemical analysis by authors [3] using ICP and revealed that ionic contaminants of iron, aluminum, titanium, calcium, sodium, and potassium exist in trace amounts (with total < 1000 ppm). Boron and phosphorous were also found to exist but with amounts < 10ppm rendering this sand to be attractive for solar cell use.

Methodology

The as-received (AR) material is sand stone cores, withdrawn from bore holes from Al-Shibat formation site. The deposit site is located in northwestern part of Libya close to Sabha City. A sandstone piece was crushed, ground, and then quartered to get about 200 grams representative as-received (AR) samples. Small portion of crushed AR sand was imbedded in Epoxy and polished to a sub micron finish. BSE Images were acquired on a Hitachi W filament S3400N VP SEM coupled with an Energy Dispersive detector (EDAX).

Results and Discussion

The as-received (AR) sand stones from the Al-shibat deposit site essentially have a yellowish color; with a large portion of the sand particles agglomerating into small chunks. Fig. 1 shows an SEM cross sectional image of an enlarged AR sand particle containing a white contrasted surface spot. In this particle, the grey color major phase was found to be pure silica (SiO2). The white region is identified by EDAX as Rutile (TiO2) plus kaolinte (aluminium silicate hydroxide), see Fig. 2. Analyses of other particles in AR sand reveal the existence of Zr, Ca, K, and Al impurities plus other minor impurities. The existence of Ca and

Al impurities indicate the existence of minerals like mica and kaolinite as supported by x-ray diffraction analysis [3].

Conclusions

In this work, impurity minerals detected by SEM BSE-EDAX technique agree well with previous Inductively Coupled Plasma-Atomic Emission Spectroscopy (ICP-AES) and x-ray diffraction analysis. These techniques indicate that Al-Shibat sand is of high purity suitable for high Technology use.

Acknowledgement

The authors would like to thank The University of Tripoli, and The National Institute for Scientific Research-Tripoli-Libya, for funding this research study. Special thanks to Dr. Thomas F. Kelly and Dr. John A. Fournelle at University of Wisconsin, Madison for help with SEM work.

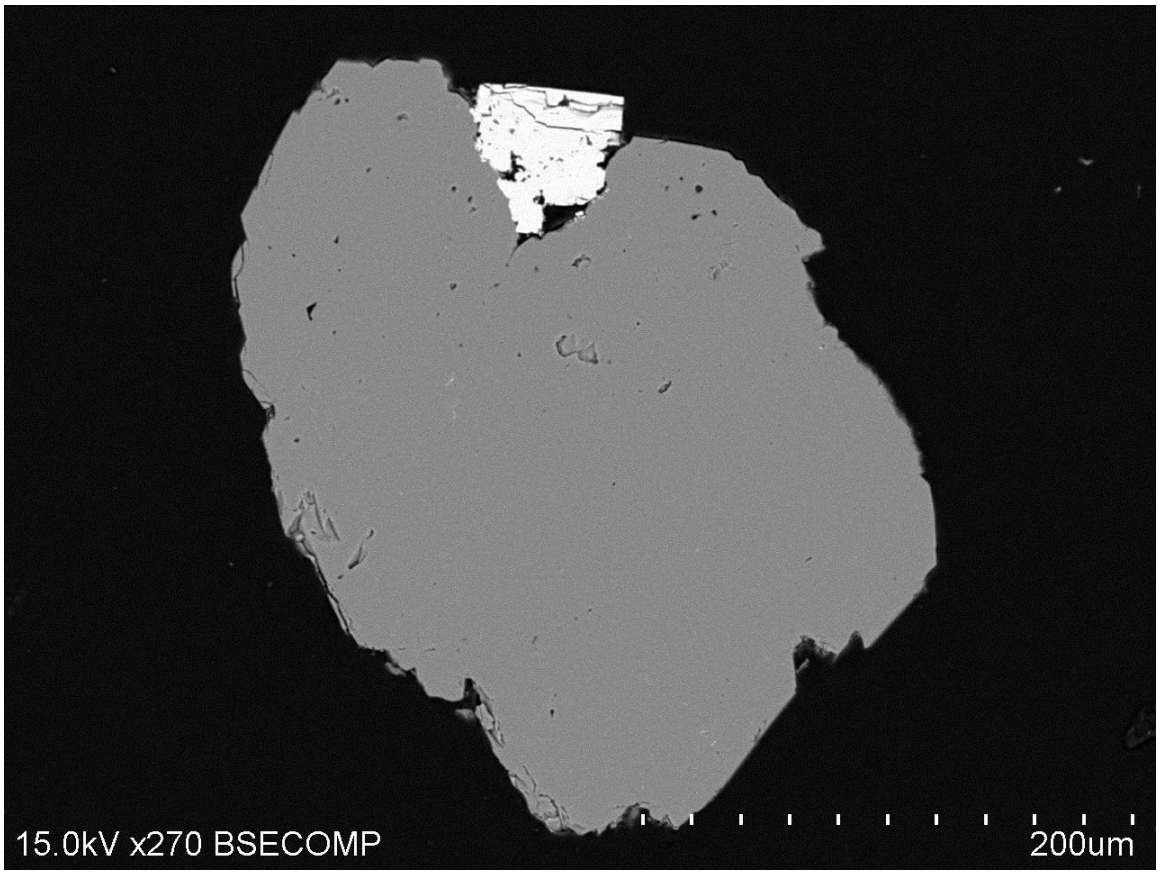

Figure 1. Al-Shibat sand particle showing a white contrasted surface impurity.

https://doi.org/10.1017/S1431927620022965 Published online by Cambridge University Press

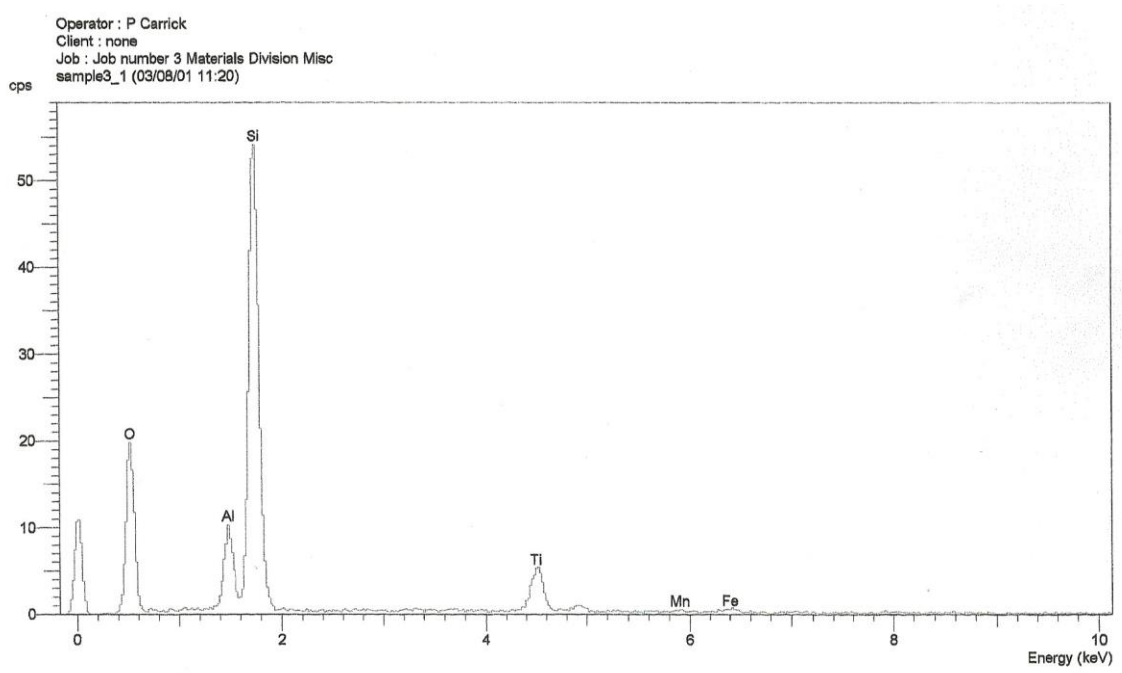

Figure 2. EDAX spectrum of white impurity of Fig. 1.

References

[1] Lyman, C. E., Goldstein, J. I., Romig Jr., A. D., Echlin, P. , Joy, D. C., Newbury, D. E., Williams, D. B., Armstrong, J. T. Fiori, C. E., Lifshin, E., and Peters, K-R. (1990).Scanning Electron Microscopy, X-Ray Microanalysis, and Analytical Electron Microscopy, *A Laboratory Workbook*, Plenum Press, New York, pp.300.

[2] Kheloufi Abdelkrim, Berbar Yassine, Kefaifi Aissa, Medjahed Sid Ali, Kerkar Fouad (2011). Improvement of Impurities Removal from Silica Sand by Using a Leaching Process . Semiconductor Technology Research Centre, Department of Raw Materials and Crystal Growth, Algeria.

[3] R. M. Dweiby, R. M. (2017), Investigation of Three High Quality Libyan Sands for Industrial and High Tech. Utilization. M.S. Thesis, University of Tripoli-Libya.

https://doi.org/10.1017/S1431927620022965 Published online by Cambridge University Press