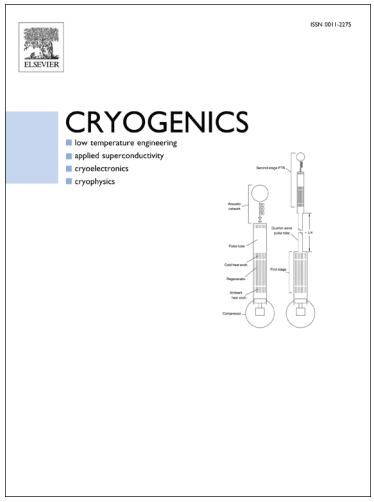
Accepted Manuscript



Low-frequency internal friction as express-method for identification of cryocrystals in pores of the solids

A.I. Erenburg, A.Yu. Zakharov, A.V. Leont'eva, A.Yu. Prokhorov

PII: S0011-2275(16)30098-4
DOI: http://dx.doi.org/10.1016/j.cryogenics.2016.06.002
Reference: JCRY 2585

To appear in: *Cryogenics*

Received Date: 23 April 2016
Revised Date: 28 May 2016
Accepted Date: 1 June 2016

Please cite this article as: Erenburg, A.I., Zakharov, A.Yu., Leont'eva, A.V., Prokhorov, A.Yu., Low-frequency internal friction as express-method for identification of cryocrystals in pores of the solids, *Cryogenics* (2016), doi: http://dx.doi.org/10.1016/j.cryogenics.2016.06.002

Low-frequency internal friction as express-method for identification of cryocrystals in pores of the solids

A.I. Erenburg[1], A.Yu. Zakharov[2], A.V. Leont'eva[3], A.Yu. Prokhorov[3]

[1]Ben-Gurion University of Negev, P.O.B. 653, Beer-Sheva 84105, Israel
E-mail: erenburga@gmail.com, erenbura@bgu.ac.il
[2]Novgorod State University, B. S.-Peterburgskaya str. 41, Velikiy Novgorod 173003, Russia
E-mail: anatoly.zakharov@novsu.ru
[3] Donetsk Institute for Physics & Engineering, NAS of Ukraine, Prospect Nauki 46, Kiev, 03680, Ukraine; E-mail: vesta-news@yandex.ru, tonya.leont@gmail.com

Abstract.

We show that studying of low-frequency internal friction (LFIF) of solid samples at low temperatures allows determining the presence of various gases absorbed, for some reasons, in pores and caverns of the solids. The gases come over to a solid state (cryocrystals) and exist in the pores under corresponding thermodynamic conditions giving an additional contribution to the LFIF spectra. The spectra reflect the special points of the gases (temperatures of melting or phase transitions). This information gives a real opportunity for identification of gas in the matrix, i.e. the studied solids. This may be of great importance for investigations of cosmic or geological samples, for instance, asteroids, meteorites, rock formations, etc. The LFIF method allows identification of gas media surrounding the studied sample.

Introduction.

Cryocrystals (or solidified gases) form a relatively small group of materials which are gaseous at room temperatures and solids at low ones. They have triple points at low temperatures because of low weight and small size of their molecules and also weakness of binding forces. This group of solids includes atomic cryocrystals (He, Ne, Ar, Kr, Xe), simplest molecular crystals (hydrogen, nitrogen, CO, oxyge**n) a**nd also few crystals from larger molecules (CO_2, N_2O, CH_4, NH_3 etc.) [1]. Being chemically neutral, the gases fill the pores and becomes cryocrystals under cooling, influencing the properties of solid matrices.

Method of internal friction used in the paper permits to detect a presence of gases in pores of the matrix as the cryocrystals give an additional contribution in background spectrum of crystal matrix in the form of additional peaks. Temperatures of triple points are the control points for most of the cryocrystals. For molecular cryocrystals, the control points include the temperatures of phase transitions as well.

I. Problems of oxide ceramics and determination of gaseous oxygen existence in its pores

Oxide ceramics are usually fabricated by sintering and have numerous internal pores. These pores can absorb various gases influencing the mechanical, thermodynamic or other properties of the materials.

Investigations of gas media influence on the properties of the solids represent a very extensive area. It includes the studies of influence of gas solved in the solid, gas in pores and gas condensed on the surface, on various characteristics of the ceramics. A problem of influence of oxygen media on various properties of the ceramics can be analyzed separately. For instance, it