View metadata, citation and similar papers at core.ac.uk

brought to you by CORE

provided by The Australian National University

Direct observation of the major components of mouse bones and related compounds by electron Rutherford backscattering spectroscopy

This content has been downloaded from IOPscience. Please scroll down to see the full text.

2014 J. Phys.: Conf. Ser. 488 052010

(http://iopscience.iop.org/1742-6596/488/5/052010)

View the table of contents for this issue, or go to the journal homepage for more

Download details:

IP Address: 130.56.5.134
This content was downloaded on 19/11/2014 at 03:01

Please note that terms and conditions apply.

XXVIII International Conference on Photonic, Electronic and Atomic Collisions (ICPEAC 2013) IOP Publishing
Journal of Physics: Conference Series **488** (2014) 052010 doi:10.1088/1742-6596/488/5/052010

Direct observation of the major components of mouse bones and related compounds by electron Rutherford backscattering spectroscopy

M. Vos,[†] [1] K. Tőkési,[*] and I. Benkő[§]

[†] Research School of Physics and Engineering, Australian National University, Canberra ACT Australia
[*] Institute of Nuclear Research of the Hungarian Academy of Sciences, Debrecen, Hungary, EU
[§] Department of Pharmacology and Pharmacotherapy, Medical and Health Science Center, University of Debrecen, Hungary, EU

Synopsis We present measurements, using electron Rutherford backscattering spectroscopy (eRBS), aiming to estimate the concentration of the various elements in mouse bone. We first successfully determined the composition of calcium carbonate, followed by an analysis of the more complicated case of hydroxyapatite. Finally we studied bone powder itself and established in this way that eRBS presents an interesting new flavor of microanalysis.

In the past years there is increasing research interest in the accurate determination of the composition of bone samples, as various major and trace element concentrations in bones turn out to be good indicators of several diseases. Also bone is one of the places in the body where toxic elements accumulate.

Recently it became possible, using high energies and large scattering angles, to resolve the recoil energies of electrons scattered from atoms with considerable mass differences. This technique, called electron Rutherford backscattering spectroscopy (eRBS), relies on the quasi-elastic electron-atom scattering. The energy of the elastically scattered electrons is decreased from its initial values due to the recoil energy acquired by the scattering atom. This recoil energy depends on the mass of the scattering atom and the quasi-elastic peak splits thus into several components.

The concentration of the various elements in mouse bone powder was studied by eRBS at 40 keV primary energy. As reference measurements calcium carbonate and hydroxyapatite were also investigated. We obtained a very good understanding of spectra of the latter two materials. Agreement between the measured and actual composition are at a respectable 10% level. The actual bone samples showed more variation in composition and a good fit of these spectra is only achieved, using the peak widths obtained for the hydroxyapatite sample, if one allows for the presence of impurity atoms with a mass close to that of Na and Mg (see Fig. 1). Thus eRBS becomes a useful tool to study bone mineralization. More generally, a meaningful interpretation of eRBS spectra of more complex samples in terms of composition is indeed possible, if the widths of the peaks contributing to the spectra are known.

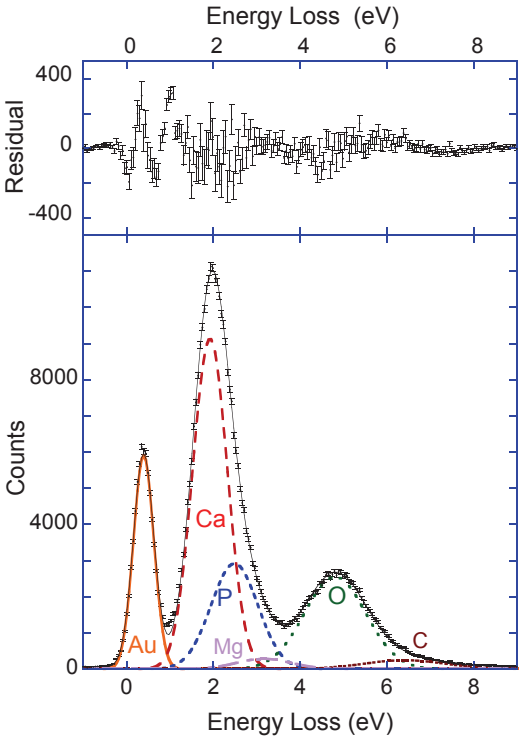

Figure 1. A fit of a mouse bone spectrum with all widths fixed to the corresponding values obtained in hydroxyapatite and $CaCO_3$ spectra.

Acknowledgements

This research was made possible by a grant of the Australian Research Council, the Medical and Health Research Council of Hungarian government (ETT293/2009) and the Hungarian Scientific Research Fund OTKA No. NN 103279.

[1] E-mail: Maarten.Vos@anu.edu.au

Content from this work may be used under the terms of the Creative Commons Attribution 3.0 licence. Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI.
Published under licence by IOP Publishing Ltd