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Vibrational (Infrared and Raman) Spectra of Minerals and Related Compounds

Springer

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Alexandr Dmitrievich Chervonnyi
1948–2017

This book is dedicated to the memory of the outstanding scientist, a specialist in the field of inorganic materials and chemistry of rare-earth elements Dr. Alexandr Dmitrievich Chervonnyi. Him belongs the idea to publish this book.

Preface

This volume is the third and final part of the series of reference books on vibrational spectra of minerals. Unlike the two previous parts (Chukanov 2014; Chukanov and Chervonnyi 2016), this book contains not only infrared (IR) spectra of minerals but also data on their Raman spectra.

In Chap. 1, numerous examples of the application of IR spectroscopy to the analysis of crystal-chemical features of minerals are considered. In particular, spectral bands that characterize different local situations around OH^- and BO_3^{3-} groups in vesuvianite-group minerals are revealed. The effect of symmetry on the parameters of IR spectra of vesuvianite-group minerals is discussed. By means of IR and Raman spectroscopic methods, it is shown that the clathrate mineral melanophlogite is not a single species but a mineral group including minerals with different combinations of small molecules (CO_2, CH_4, H_2S, N_2, H_2O, C_2H_6) entrapped in structural cages. Based on numerous IR spectra of nakauriite samples from different localities, it is demonstrated that this mineral does not contain sulfate groups, and its tentative simplified formula $(Mg_3Cu^{2+})(OH)_6(CO_3)\cdot 4H_2O$ is suggested. A close crystal chemical relationship between nepskoeite and shabynite is demonstrated based on their IR spectra, compositional, and X-ray diffraction data. Contrary to the formula $Mg_4Cl(OH)_7\cdot 6H_2O$ accepted for nepskoeite, this mineral is a borate with the tentative simplified formula $Mg_5(BO_3)(Cl,OH)_2(OH)_5\cdot nH_2O$ ($n > 4$). Consequently, shabynite may be a product of nepskoeite dehydration. Based on IR spectroscopic data, it is also shown that some nominally boron-free lead carbonate minerals (molybdophyllite, hydrocerussite, plumbonacrite, somersetite) often contain minor BO_3^{3-} admixture which is overlooked in structural and chemical analyses.

Chapter 2 contains IR spectra of 1024 minerals and related compounds which were not included in the preceding reference books of this series (Chukanov 2014; Chukanov and Chervonnyi 2016). Most spectra are accompanied by the information about the origin of reference samples, methods of their identification, and analytical data.

In Chap. 3, possibilities, advantages, and shortcomings of Raman spectroscopy as a method of investigation and identification of minerals are discussed. Numerous examples illustrate capabilities of Raman spectroscopy in identification of minerals and analysis of their crystal chemical features, orientation, and polarization effects, selection rules, as well as difficulties encountered in the study of microscopic inclusions in minerals and minerals that are unstable under laser beam.

Chapter 4 contains data on 2104 Raman spectra of more than 2000 mineral species taken from various periodicals. The data are accompanied by some experimental details and information on the reference samples used.

A supplementary chapter provides comments on published IR spectra which are erroneous, dubious, or of poor quality. This chapter is provided by a separate list of references.

This work was carried out with assistance of numerous colleagues. The working partnership with Prof. I.V. Pekov, Dr. A.D. Chervonnyi, and Dr. S.A. Vozchikova was the most important.

Reference samples and valuable analytical data were kindly granted by A.V. Kasatkin, S. Jančev, E. Jonssen, R. Hochleitner, E.V. Galuskin, S. Weiss, N.V. Sorokhtina, Ł. Kruszewski, and many other mineralogists, as well as mineral collectors, of which the contribution of R. Kristiansen, G. Möhn, W. Schüller, B. Ternes, G. Blass, B. Dünkel, S. Möckel, and C. Schäfer was the most important. Collaboration with the crystallographers N.V. Zubkova, R.K. Rastsvetaeva, S.M. Aksenov, D.I. Pushcharovsky, T.L. Panikorovskii, O.I. Siidra, S.N. Britvin, M.G. Krzhizhanovskaya, D.A. Ksenofontov, S.V. Krivovichev, and I. Grey, as well as with specialists in different areas of geosciences and analytical methods (J. Göttlicher, K.V. Van, D.A. Varlamov, V.N. Ermolaeva, D.I. Belakovskiy, Yu.S. Polekhovsky, P. Voudouris, A. Magganas, A. Katerinopoulos, N.V. Shchipalkina, V.O. Yapaskurt, L.A. Pautov, V.S. Rusakov, R. Scholz, A.R. Kampf, S. Encheva, P. Petrov, Ya.V. Bychkova, N.N. Koshlyakova, P. Yu. Plechov, C.L.A. de Oliveira, I.S. Lykova, and T.S. Larikova) was especially fruitful. All of them are kindly appreciated.

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Reference

Chukanov NV, Chervonnyi AD (2016) Infrared spectroscopy of minerals and related compounds. Springer, Cham. (1109 pp)

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