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# STRUCTURE AND PHYSICAL PROPERTIES OF MIXED PHOSPHATES OF COBALT AND NICKEL WITH CADMIUM

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## INTRODUCTION

Two mixed phosphates $CdM_2(PO_4)_2$, where M=Co(II) and Ni(II), not described in literature so far, are synthetized and a series of investigations is performed. However, the crystal structure of $CdZn_2(PO_4)_2$ has been described in literature /1/. This fact is interesting since there is a possibility, in principle, for isostructurality of Zn- and above state M(II) compounds. One of the specific features of $CdZn_2(PO_4)_2$ crystal structure is the existence of two different low - symmetric coordination surroundings of Zn-ions: tetra-coordination and hexacoordination.

## SYNTHESIS

Synthesis of mixed Cd-Co and Cd-Ni phosphates is realised by applying the procedure addopted for the synthesis of Cd-Zn phosphate /1/. The synthesis gives homogeneous polycrystalline samples. Investigations described in this paper are performed on specimens obtained by grinding the synthesis products into fine powder.

## CRYSTALLOGRAPHIC DATA

The syntetized compounds are investigation by the method of x-ray diffractometry. This study shown that both crystals possess monoclinic symmetry and enabled determination of the unit cell parameters for those crystals. The corresponding data are given in Table 1. The parameter values from Table 1.

Table 1.

| compound | unit cell parameters | | | |
|---|---|---|---|---|
| | a(nm) | b(nm) | c(nm) | $\beta$ (°) |
| $CdCo_2(PO_4)_2$ | 0,8860 | 1,1470 | 0,5930 | 100,3 |
| $CdNi_2(PO_4)_2$ | 0,8940 | 1,2110 | 0,5932 | 99,3 |

are close to the parameter values for $CdZn_2(PO_4)_2$ /1/, pointing out, in certain way, to possible isostructurality of these compounds.

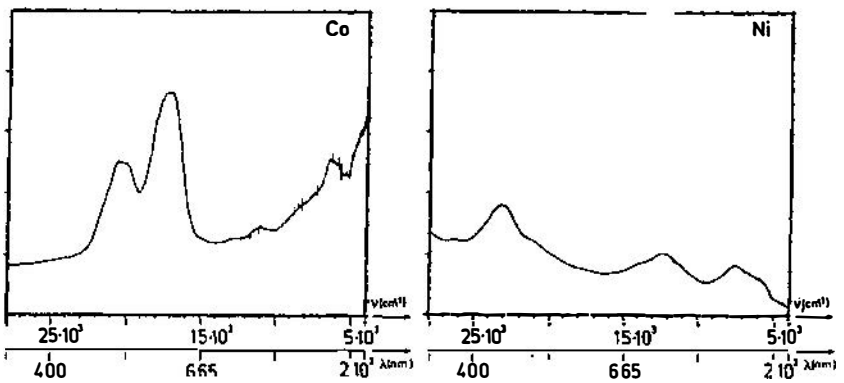


Fig.1.

OPTICAL SPECTRA

The synthetized compounds are investigated also by the method of diffuse reflectance spectroscopy. Optical spectra are recorded within the range of 357nm ÷ 2500 nm (i.e. $2{,}8.10^{4}cm^{-1} \div 4.10^{3}cm^{-1}$) at a room temperature with Ba $SO_4$ as a reference sample. The spectra are given in Fig.1. Comparison of these spectra with the spectra of Co(II) and Ni(II) compound (crystal i.e. ligand field spectra) stated in the literature as examples /2,3/, indicates that these spectra spectra cannot be attributed to crystal field of usual symmetry i.e. to usual coordination surroundings for the cited ions. This speaks in favour of the assumption that the spectra obtained are the result of superposition of two M(II)-ion spectra in different low-symmetrical surroundings existingin the structure of $CdZn_2(PO_4)_2$. Spectroscopy, however does not allov a reliable confirmation of such a conclusion /2,3/.

MAGNETIC, DIELECTRIC AND ELECTRIC MEASUREMENTS

Investigation of synthetized compounds covered also the determination of temperature dependence within wide temperature interval for:

a. Magnetic (mass) susceptibility ($\varkappa_m$) by applying the Gouy method; measuring results are given in Fig.1.,
b. Dielectric (relative) permitivity ($\varepsilon_r$) by applying the high-frequency measuring bridge (at 1 MHz); measuring results are given in Fig.3.,
c. Specific electric resistivity ($\rho$) by applying electrometric methods; measuring results are given in Fig.4.

Measurements under b. and c. are carried out on pellets made of powder pressed under 5 MPa pressure. Briefly, lines in Figs. 2 ÷ 4, show that dependences $1/\varkappa_m$, $\varepsilon_r$ and $\ln\rho$ from temperature (T) have the forms characteristical for paramagnets, linear dielectrics and electronic conductivity systems.

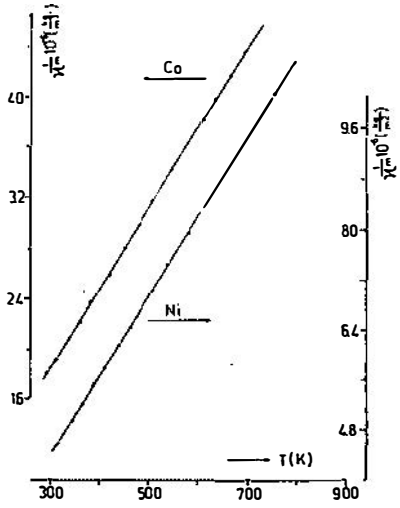


Fig.2.

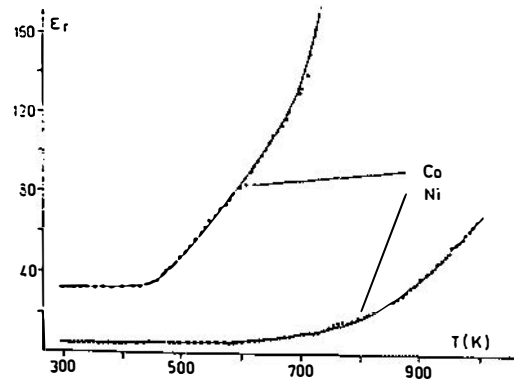


Fig.3.

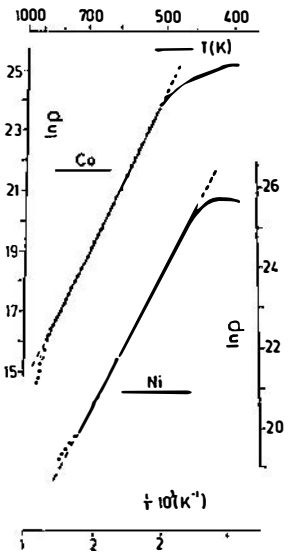


Fig.4.

The Fig.2. enables calculation of the magnetic moments of M(II)-ions more precisely, paying attention to possible crystal structure (two coordinations of M(II)-ions) perhaps mean magnetic moments are concerned. Calculation (for example /4/) gives for Co(II)-ion 4,70 $\mu_B$ and for Ni(II)-ion 3,25 $\mu_B$ (where $\mu_B$=Bohr's magneton), indicating a relatively high degree of quenching of the orbital moment /4/.

It should be also noticed that the lines in Figs. 2.÷ 4. do not show any discontinuity ("break") which could speak in favour of the existence of structural phase transitions within the examined temperature range. The existence of structural phase transitions is a feature of a great number of simple and mixed phosphates /5,6/ i.e. of compounds with tetrahedral ions /6/.

## CONCLUSION

Syntesis of compounds not described so far is performed and certain number of investigation made: crystal symmetry is defined and the unit cell parameters are determined; by recording of the optical reflection spectra the information on the coordination surrounding of Co and Ni-ions is obtained and the temperature dependence of the some physical properties studied.

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