Summary and Conclusions

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The present thesis includes, the preparation of Zn(II), Cu(II), Ni(II), Co(II) and mixed Co(II)-Ni(II) complexes of nicotinic as well as isonicotinic acids. Also, it deals with the study of kinetic of thermal decomposition, DC- and AC-electrical conductivity, dielectric constant, dielectric loss and magnetic properties of these acids and their complexes.

The thesis comprises three chapters:

Chapter I: Deals with the introduction and literature survey on the previous studies which were carried out on the complexes of nicotinic as well as isonicotinic acids. Also, it contains the aim of work and theoretical principle underlying the methods used in the present study.

Chapter II: Is divided into two parts: The first part covers the experimental part, including the instruments used, materials and preparation of the pure and mixed complexes.

The second part of this chapter is concerned with the characterization of the investigated samples using elemental analysis, FT-IR and thermal analysis (DTA-TG).

The FT-IR spectra indicate the participation of both nitrogen and oxygen atoms in complex formation and the thermal stability was found to decrease for nicotinic acid and their complexes in the order:

Nicotinic acid > Cobalt-nickel nicotinate > Cobalt nicotinate > Zinc nicotinate > Nickel nicotinate > Copper nicotinate

While for isonicotinic acid and its complexes decrease in the order:

Isonicotinic acid > Nickel isonicotinate > Cobalt isonicotinate > Cobalt-nickel isonicotinate > Copper isonicotinate > Zinc isonicotinate.

Chapter III: Is divided into five parts: The first part deals with the kinetic of thermal decomposition of the investigated samples using dynamic TG curves by applying three integral dynamic models due to Coats-Redferns, Ozawa and composite methods. The kinetic dehydration step for each compound investigated was found to be best described by the mechanism of two dimensional phase boundary (R_2). And the activation energy of the dehydration process of nicotinic acid and their complexes, calculated using composite methods, decrease in the order:

Zinc nicotinate > Cobalt nicotinate > Nickel nicotinate >

Cobalt-nickel nicotinate

While for isonicotinic acid and its complexes decrease in the order:

Cobalt isonicotinate > Nickel isonicotinate >

Cobalt-nickel isonicotinate > Copper isonicotinate

The second part of this chapter is concerned with the study of DC-conductivity of the nicotinic, isonicotinic acids and their complexes at temperature range from 78K to temperature just before the decomposition temperatures of the investigated samples. This temperature range has been applied for all conductivity, dielectric constant and dielectric loss.

Several conduction mechanism depending on the composition of the investigated compounds have been observed from DC-results. At room temperature the DC-conductivity was found to increase for nictinic acid in the order:

Cobalt nicotinate < Nicotinic acid < Nickel nicotinate <

Cobalt-nickel nicotinate

While for isonicotinic acid and its complexes:

Nickel isonicotinate < Zinc isonicotinate < Cobalt-nickel

isonicotinate < Isonicotinic acid < Cobalt isonicotinate.

The activation energy of the conduction process was found to be affected by the complexation and the type of transition metal ions. The charge transfer was suggested to be occurring via new molecular orbital formed by chelating of the ligand with the metal ions and not voa the ligand molecules.

The third part deals with the study of AC-conductivity of the investigated samples at frequencies ranging from 10^2-10^6 Hz.

Generally, for all samples σ_{AC} was found to be higher than that of σ_{DC} and in most cases σ_{AC} was found to increase with the applied frequency ω according to $\sigma_{AC}=A\omega^{s'}$. For nicotinic acid and its complexes the σ_{AC} was found to increase in the order:

At lower temperatures:

Co-Ni nicotinate < Nicotinic acid < Cu-nicotinate < Co-nicotinate <

Zn-nicotinate < Ni-nicotinate.

At higher temperatures:

Co-Ni nicotinate < Nicotinic acid < Cu-nicotinate < Co-nicotinate

< Ni-nicotinate < Zn-nicotinate.

isonicotinate at T = 270 K, copper-isonicotinate at T =190 K and for Co-Ni isonicotinate at T = 190 K.

The ε`-value at room temperature was found to increase in the order:

For nicotinic acid and its complexes:

Nicotinic acid < Copper nicotinate < cobalt nicotinate < Zinc nicotinate < nickel nicotinate

And for isonicotinic acid and its complexes:

Nickel isonicotinate < Zinc isonicotinate < Isonicotinic acid < Cobalt isonicotinate < Copper isonicotinate.

The ε`-values deduced for nicotinic and isonicotinic acids and their complexes except Cu or Co isonicotnate, are less than 40, so that these compounds are classified as simple dielectric materials with ionic polarization. But cobalt and copper isonicotinates showed ε`-values higher than 100 at room temperature which lead us to classify these compounds as exhibit ferrielectric properties.

The fifth part deals with the study of magnetic properties at temperature range between 78 K and temperature just before the decomposition temperature of the investigated compounds. The nicotinic and isonicotinic acids and their zinc complexes showed diamagnetic properties. While the other complexes investigated showed, para- and antiferro-magnetic properties depending on the composition and the temperature range at which the complexes investigated. The breaks occurring in $\chi_M T$ vs. T plots were found at temperatures coincide well with those reported by electrical measurements.

These results are discussed and interpreted according to the different magnetic models.