In this thesis the dc & ac electrical conductivity and dielectric properties of selected Sulphate and sulphamate single crystal have been investigated. Two mixed Sulphate crystal namely Lithium Hydrazinium Sulphate (LHS) & Lithium Hydroxylammonium Sulphate (LHAS) and two Sulphamate crystals namely Sulfamic acid and Potassium Sulphamate are investigated in this work. The values of dc conductivity, ac conductivity and the dielectric constant are reported for the first time except for LHS crystals. Phase transition studies on the above said crystals have also been investigated using the measured electrical conductivity and dielectric properties.

Large size single crystals of these Sulphate and sulphamate crystals are necessary for the electrical conductivity measurements, since these properties are measured in all possible directions. These crystals are not readily available and hence they are grown in the laboratory as a part of the present work. Crystal growth apparatus with temperature controller have been fabricated. A dielectric cell, for the measurement of ac and dc conductivity studies, have been designed and fabricated. This dielectric cell can be used
for mounting the crystal for measurement for both in the low temperature region and in the high temperature region.

Lithium Hydrazinium Sulphate crystal is an extensively studied crystal. Results of the dc electrical conductivity measurements showed anomalies in the temperature variation of dc conductivity at around 425K. These anomalies are explained as due to a weak phase transition in the LHS crystal near 425K. The temperature variation of ac conductivity and dielectric study show weak anomalies in the temperature region 410K-420K. Earlier reports on thermal expansion study, NMR study and temperature variation of Elastic constant study are also found to be consistent with the present inference of this weak phase transition. Both ac & dc conductivities and dielectric studies uphold the occurrence of phase transition at around 425K. The experiments were repeated for several times for several samples.

DC and ac electrical conductivity studies in Lithium Hydroxylammonium Sulphate single crystal are conducted for the first time. The present study reports three anomalies at around 248K, 267 K and at 370 K. These anomalies are observed for the first time. The variation of dc conductivity with temperature in the low temperature region shows anomalies at around 248K and at 267 K along a and c-axes. Low temperature ac conductivity measurements also show a conductivity anomaly around 248K and at 267K along both axes. The anomaly observed at 248K is a weak one and the anomaly observed at 267K is broad in nature. The variation of conductivity and dielectric values near the vicinity of the transition temperature (267K) is very abrupt, and hence these anomalies may be attributed as phases transition that occurring in the crystal at this temperature. The variation of dc conductivity with temperature in the high temperature region shows an anomaly at around 370 K. A change of slope at 370 K and the increasing value of the conductivity at around 370 K are observed for a and c- axes in the ac and dielectric studies, and it may be attributed as a phase transition. In the general data of the X-ray crystal study it has been shown that the crystal decompose after 110°C (380K). But our conductivity measurements experiment is contradictory to this result. The results obtained for heating cycle could not be repeated for cooling cycle if the sample gets
decomposed. But same behavior was observed in the cooling and heating cycle. Hence it can be argued that the crystal may not decompose at this temperature and the anomaly observed at around 370 K may be attributed as a phase transition occurring in the crystal at this temperature. The TGA analysis on this crystal shows that the sample doesn't decompose at 380K but decompose 7.94% of its mass at 420K. From the plots of the dielectric spectra one can seen the spectra is similar to the relaxor behaviour observed in some ferroelectric materials. The dielectric constant Vs temperature graph shows broad maxima, may be attributed as a diffuse phase transition, which is also a characteristic feature of the relaxor ferroelectric.

The dc and ac conductivity measurements are carried out in the Sulphamic acid single crystal along [100], [010] and [001] directions and reported for the first time. The dc conductivity studies reports four conductivity anomalies at around 250 K, 290K, 340K and 450K. The ac conductivity study also reports three anomalies at around 250 K, 290 K, and at 335K. A sharp increase in the value of ac conductivity at around 420K may be attributed as a beginning of a phase transition that occurs at 450K. The weak anomaly observed at 250 K in the dc conductivity studies is found to be very strong in the ac conductivity studies while the distinct peak observed at 290 K in the dc conductivity studies is found to be very weak in the ac conductivity studies. Low temperature ac conductivity measurements show a conductivity anomaly in the temperature range 250K- 255K along a, b and c-axes. The variation of dielectric constant with temperature along a and c-axes shows a dielectric anomaly at 255K. The anomalous changes that observed in the dielectric value and in the conductivity value is very abrupt in this temperature region. The ac electric conductivity value increases three orders of magnitude at the vicinity of the transition temperature. The variation of ac electrical conductivity along a, b and c-axes in a very narrow temperature region 270K-300 K is plotted in order to verify the anomaly that observed in the dc conductivity at 290 K. The plot shows the value of ac conductivity increases very sharply around 295K along a-axis and the value decreases sharply in the region 289 K--293K along b-axis. The results also show the value of ac conductivity decreases sharply in the region 282-292 K along c-axis. All the curves show some anomalies at around this temperature region. These
anomalies are very weak and could not observe when the curve is plotted in the full-scale range. Another anomaly was found in Sulphamic acid crystal is at 345K. A change of slope was noticed in the variation of conductivity with temperature curve at 345 K along a, b and c-axes. Thermal expansion study in betaine H[NH₂SO₃] shows a steep increase of about 1.5% along a, near 360K. A change of slope was also observed at 332 K along a, b and c-axes in the ac conductivity studies. Again a change of slope was clearly noted when the measurements are carried out in the cooling cycle. This can be attributed as phase transition occurring in the crystal. Similar behaviors are observed along a, b and c-axes. A sharp increase in the value of ac conductivity was observed after 420 K. Earlier reports suggest that most of the sulphamate exhibit a first order phase transition around 450 K. Hence an exponential increase in the value of conductivity at around 420 K may be attributed as a phase transition occurring in the crystal at 450K. DTA curve shows a differential peak at around 460K indicating a possible phase transition. The TGA & DTA studies are carried out in the sulfamic acid crystal. The results shows that the crystal is very stable upto 450K. The Thermo Gravimetric Analysis shows no mass reduction in the 303K-450K regions and the crystal is very stable upto 450K. Earlier reports also confirm the stable nature of the crystal.

The dc & ac electrical conductivity and dielectric constants of potassium sulphamate single crystal was measured for the first time. The dc electrical conductivity study reports three conductivity anomalies at around 265K, 340K and at 420K. These anomalies are observed along [100], [010] and [001] directions also can be repeatable for cooling and heating cycles. Results of the dc electrical conductivity measurements showed anomalies in the temperature variation of dc conductivity at around 265K. Again, the variation of dielectric constant with temperature in the temperature region 243- 303K shows an anomalous behaviour at around 262 K. The variation of ac conductivity with temperature also shows an anomaly at this temperature. In the high temperature region a change of slope was noticed at around 340K in the dc conductivity studies. A change of slope was also observed at 340 K in the ac conductivity studies for heating and cooling cycle. Conductivity anomalies are observed at 420K along a and b-axes. An increase in the value of dc conductivity after 400 K may be attributed as a
beginning of phase transition occurring at 420K. A dielectric peak was observed at around 420K. Also ac conductivity and dielectric studies in the high temperature region shows an exponential increase in conductivity values at around 400K along c-axis, while along a and b-axes this increase were observed at around 380K. These conductivity and dielectric anomalies at 265 K, 340K and at 420K are observed for the first time. TGA analysis shows the crystal is stable upto 450K.

From the above conclusion it was clear that certain anomalies are common for both Sulfamic acid and potassium sulphamate crystals. These anomalies are observed at around 250 K, 290K, 345K & 450K for sulfamic acid and at around 265K, 340K & 420K for the potassium sulphamate crystal. A possible reason for these common anomalies may be due to either the sulphamate group or NH₂ group is responsible for the phase transition at these temperatures. Earlier reports on several sulphamate crystals shows that the variations of certain properties like elastic constant, thermal expansion etc are similar. Lithium Hydroxylammonium Sulphate shows three anomalies at around 248K, 267K and at around 370K whereas Lithium Hydrazinium Sulphate shows only a weak anomaly at around 425K.

It is clear that further studies are required to answer many question raised in this thesis and to confirm some of the conclusions. In particular, this is true for the phase transition studies in sulfamic acid, Potassium Sulphamate and lithium Hydroxylammonium Sulphate crystals.