(12) INNOVATION PATENT
(19) AUSTRALIAN PATENT OFFICE

(11) Application No. **AU 2021107079 A4**

(54) Title
Type-E Orientation Pattern Using XRD

(51) International Patent Classification(s)
H01G 7/02 (2006.01)

(21) Application No: **2021107079** (22) Date of Filing: **2021.08.25**

(45) Publication Date: **2021.12.02**
(45) Publication Journal Date: **2021.12.02**
(45) Granted Journal Date: **2021.12.02**

(71) Applicant(s)
Pragya Ojha

(72) Inventor(s)
Ojha, Pragya;Malik, M. Manzar;Qureshi, M. Shums

(74) Agent / Attorney
Manish Sharma, U 89 170 Leichhardt St, Spring Hill, QLD, 4000, AU

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Abstract

The present disclosure relates to an orientation pattern for the structural studies using XRD technique. A pattern of Type-E orientation is disclosed for the XRD studies on magnetoelectrets prepared using temperature gradient method. A Magnetoelectret of 50% porous polypropylene material is prepared and its structural analysis has been done under different magnetic field and temperatures using proposed pattern of Type-E orientation. The study using disclosed orientation pattern i.e Type-E will be beneficial for developing with enhanced quality of sensors based porous materials.

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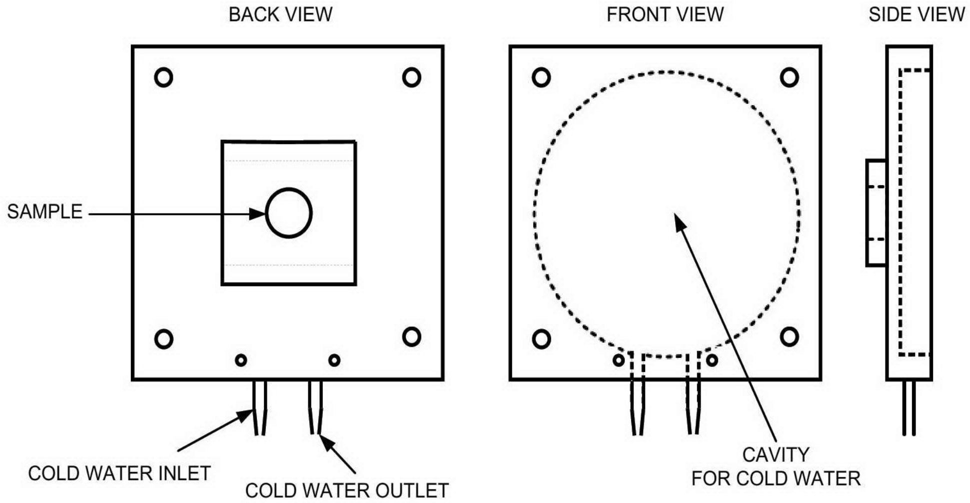

Figure 1

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Type-E Orientation Pattern Using XRD

Field of the Invention

The present disclosure relates to a pattern, a Type-E orientation using XRD technique for structural studies of porous material based electrets and its development thereof. A pattern of Type-E orientation is disclosed for the XRD studies on magnetoelectrets prepared using temperature gradient method.

BACKGROUND OF THE INVENTION

X-Ray diffraction (XRD) technique is beneficial for accurate analysis of atomic spacings in the porous material. It is essentially required to study molecular structure/structural changes occurred in the material when exposed to different physical treatments. These structural changes also occurred due to application of magnetic field or electric field as applied for the preparation of electrets which results in different molecular arrangements in the material. The present disclosure relates to the study of structural changes occurred in the solid specimen which results in different orientation patterns in the magnetoelectrets of porous material.

The impact of dielectrics in the world of science and technology is enormous with diverse applications in thermo electrical conversion, mechanical conversion, optoelectronics conversion and bio compatibility. Based on these factors electrets have found a wide range of applications. Dielectrics have a major contribution in the study of solid state physics. Dielectric samples which are named as “Electrets” in analogy with magnet because in many ways an electret is electrostatic counter part of magnet.

The growing interest in this field is evinced by the frequency of publications and world conferences, which discuss the immense possibilities of electret for many and varied practical applications. The series of applications of electret has stimulated considerable interest in the field leading to rapid increase in very recent electret research.

Electret when subjected to physical element like pressure/thermal wave, or a mechanical distortion, a signal is produced in the external circuit. The signal produced can further be effectively used to sense pressure, light, sound or electrical signals. Recent advances in electret field which led technical world to have electret devices, ranging from microphones, sensors,

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transducers, air filters and radiation dosimeters, commercially. Most of the electret based devices does not require any external power supply during the operation. The quality of such electrets is judged on their ability to hold charge for long time.

Many researchers identified preferred orientation in study of electrets using XRD. It has been observed that during the formation of electret, three types of orientation patterns are identified. Another orientation pattern i.e Type-D orientation exists in which the each unit cell is parallelopiped shaped and molecules with long chain are parallel to the length of the parallelopiped. There are basically four types of orientation patterns which are identified and classified in long chain compounds and these are Type-A, B, C and D pattern,

It is observed that these four orientation patterns are used for the rectangular samples, which uses a technique of flat transmission. And this technique is not precise and accurate for the study molecular structure/structural changes occurred in the material when exposed to different physical treatments as essentially required during the formation of electrets. Therefore, a new pattern of Type-E orientation has been identified and classified accordingly. This new pattern gives rise to new avenues in the field of electrets and its application in the solid state sensors.

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Summary of the Invention

The present invention summary is easy to understand before the hardware and system enablement were illustrated in this present invention. There have been multiple possible embodiments that do not expressly point up in this method's present acknowledgment. Here, the conditions are used to explain the purpose of exacting versions or embodiments for understanding the present invention.

Charge appearance on magnetoelectret and preferred orientation of crystallites seems to be two different phenomena not necessarily related to each other. But magnetic field does produce preferred orientation in some materials. A new Type of orientation pattern termed as Type-E (in addition to known A, B, C and D types) has been identified and developed.

Procedure to prepare magnetoelectrets with temperature gradient method is different from conventionally prepared electrets. Instead of heating two surfaces as used in conventional method, only one surface of the sample holder is heated whereas the other surface of the sample holder is maintained at lower temperature. According to this model, magnetoelectrets prepared with temperature gradient method, shows variation in intensities at different positions of magnetoelectrets samples.

It is observed while studying the disclosed Type-E orientation pattern, the nature of crystallite's orientation influenced by the strength of the magnetic field as well as by the polarizing temperature applied for the formation of magnetoelectrets. It has also been observed during study that even after attaining a steady charge the orientation pattern changes. At polarizing temperature, for porous material, there are cybotactic groups which are primarily responsible for the orientation. The size of these groups also depends on applied field and temperature required for electret formation. The dimension of these groups is reduced with increase in temperature and above polarizing temperature these groups breaks into individual molecules. There will be occurrence of local micro current with the interaction magnetic field and these groups. And this current causes the orientation of these groups in preferred direction in the presence of magnetic field against the random thermal agitated motion. It is also observed that if changes is done rapidly in temperature then the orientation pattern of these group cannot instantaneously follows the changes in external condition.

Moreover, solidification of some part of the porous material which results in locked-in strain, also causes a changes in orientation pattern and dimension of these group.

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Therefore, the two factors, first one is externally applied magnetic field and second one is inhomogeneous stress which is produced during cooling process may be the reason for pattern of Type-E orientation. Also when both factors come into the picture in the presence of magnetic field, the dimension of the cybotactic groups increases and results preferred crystallite's orientation pattern in magnetoelectret. It is important to mention here that without magnetic field, there is no sensible orientation is produced.

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Brief Description of Drawings

The accompanying drawings, which are incorporated in, constitute a part of the specification, illustrate the invention's embodiment, and the description serves to explain the principles of the invention. The various embodiments will be described under the appended drawings, which illustrate the present invention.

Figure 1 illustrates drawing of sample holder assembly to magnetoelectret with temperature gradient method.

Figure 2 illustrates experimental setup to prepare magnetoelectret with temperature gradient method.

Figure 3 illustrates disclosed pattern of Type-E orientation using XRD.

Figure 4 illustrates developed model for pattern of Type-E orientation using XRD.

Figure 5 (a) illustrate the curve of intensity at different fields and constant temperature.

Figure 5 (b) illustrate the curve of intensity at different temperature and constant field.

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DETAILED DESCRIPTION

This present invention is easy to understand with the reference of detailed figures and descriptions set forth herein. Here, various embodiments have been discussed regarding the architecture and flow chart. Some embodiments of this invention, illustrating its features, will now be discussed, and the disclosed embodiments merely exemplary of the invention that may embody in various forms.

Referring to **Figure 1** illustrates drawing of sample holder assembly to magnetoelectret with temperature gradient method**.** It is well know that the production of charges in dielectric material is highly influenced by temperature gradient. Therefore, an attempt is made to analysis the magnetoelectret prepared with temperature gradient method for pattern of Type-E orientation. The concept of temperature gradient method is applied for the first time in the preparation of magentoelectrets practically. In view of that is it essentially required to device an appropriate and efficient sample holder to prepare magnetoelectret. There is constraint of width with the holder assembly as there is only a space of 1.5 cm between the two pole pieces used for experimentation. Therefore, a modified holder assembly is shown in Figure 1. The concept of temperature gradient is to place the sample between two surfaces maintained at high and low temperature. So, to achieve this two brass plates of 9.5 cm is taken and square bakelite plate of size 4.2 cm is choosed for thermal insulation between two plates with circular hole of 1.5 cm diameter to hold sample in between.

The temperature of these two brass plates is maintained at different temperature i.e one at high temperature and other is low temperature around 8^0C-10^0C which maintained by circulating cold water continuously. The temperature of both the plates has been measured by using PT 100 sensors.

Referring to **Figure 2** illustrates experimental setup to prepare magnetoelectret with temperature gradient method. After designing holder assembly for implementing the temperature gradient method, an experimental set is to designed such that sample must be clamped in between the electromagnets as shown in Figure 2 of experimental setup. The temperature of south face is maintained around 10^0C during the entire experiment by circulating the cold water with the help of pump arrangement as shown in Figure 1. Whereas the temperature of other face is maintained at high value by using the electric coil arrangement on the other plate. At desired temperature, the

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supply of electromagnet is switched on. Then sample is allowed to cool down in the presence of magnetic field. The sample which is now a magnetoelectret is taken out for analysis purpose using different measuring techniques.

Referring to **Figure 3** illustrates a disclosed Type-E orientation pattern using XRD. The study carried out with the pattern of Type-E orientation is essentially important in porous material using XRD as it reveals information about those dielectrets which contain permanent dipoles. The role of polarizing field is very important as it affects the degree of orientation pattern in the material. The XRD has been done using Philips, Model D-8 Advanced diffractometer. In order to estimate the orientation produced, intensities were measured along the four positions i.e. at four different angles 0^0-180^0 C, 45^0-225^0 C, 90^0-270^0 C, and 135^0-315^0 C.

Referring to **Figure 4** illustrates developed model for pattern of Type-E orientation using XRD. In this reference axis aa' is the direction of field h_f and with respect to the reference axis the X-rays are falling at 0^0-$180^{0,}$ 45^0-$225^{0,}$ 90^0-$270^{0,}$ 135^0-315^0. The different angular positions for the X-rays are achieved by rotating the sample in the four positions.

Referring to **Figure 5 (a)** illustrate about the curve of intensity for different field and constant temperature. The required curve is plotted for different magnetic fields and for same temperature to confirm the theoretical outcomes of disclosed pattern of Type-E orientation in porous material.

Referring to **Figure 5 (b)** illustrate about the curve of intensity for different temperature and constant field. The required curve is plotted for different temperatures and for same magnetic field to confirm the theoretical outcomes of disclosed pattern of Type-E orientation in porous material. Hence the curve obtained validate the pattern of Type-E orientation with is outcome observed during theoretical study.

Following are the theoretical outcomes of disclosed pattern of Type-E orientation in porous material.

1) The nature of crystallite's orientation pattern in material influenced by the strength of the magnetic field as well as by the polarizing temperature applied for the formation of magnetoelectrets.
2) That even after attaining a steady charges the disclosed orientation pattern changes.
3) The crystallite's interplanar spacing which is accountable for the orientation pattern also undergoes a change.

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Hence the curve obtained in Figure 5(a) and Figure 5(b) validates the pattern of Type-E orientation in porous material.

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We Claim

1. A Type-E orientation pattern using X-Ray diffraction technique

   a pattern of Type-E orientation, is classified. It is basically an orientation pattern which gives an information about the crystallite's orientation pattern in porous material used for the preparation magnetoelectrets with temperature gradient method using XRD and

   a Type-E orientation pattern basically an orientation pattern which is detected in long chain compound has been identified and then classified as new pattern of Type-E orientation using XRD technique.

2. A new pattern as claimed in claim 1, wherein the magnetoelectret is prepared of 50 % Porous Polypropylene material using temperature gradient method and its structural information has been reported by Type-E orientation pattern analysis using XRD technique.

3. A new pattern as claimed in claim 1, wherein the observation revealed from the pattern of Type-E orientation using XRD that the crystallite's orientation pattern in porous materials not only depends on polarizing temperature but also on the strength of magnetic field.

4. A new pattern as claimed in claim 1, wherein the two factors, first one is externally applied magnetic field and second one is inhomogeneous stress which is produced during cooling process may be the reason for pattern of Type-E orientation.

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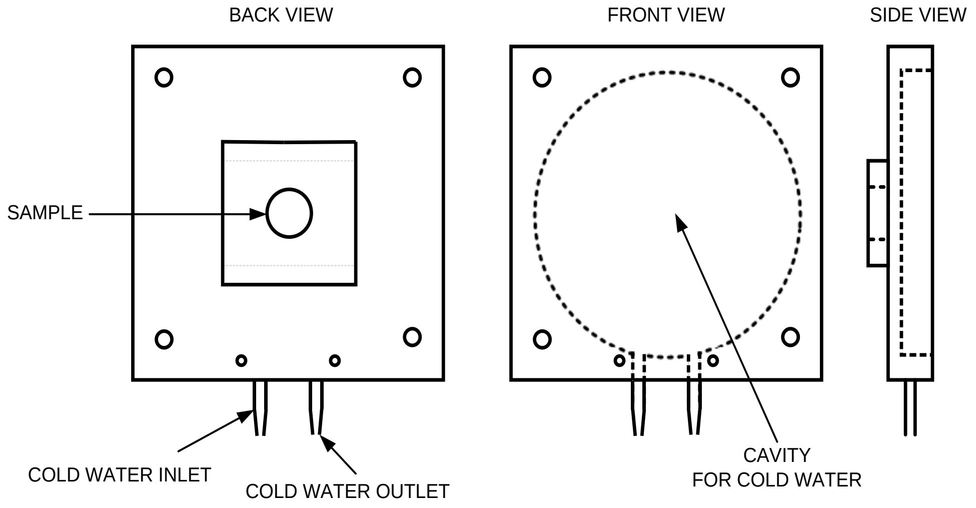

Figure 1

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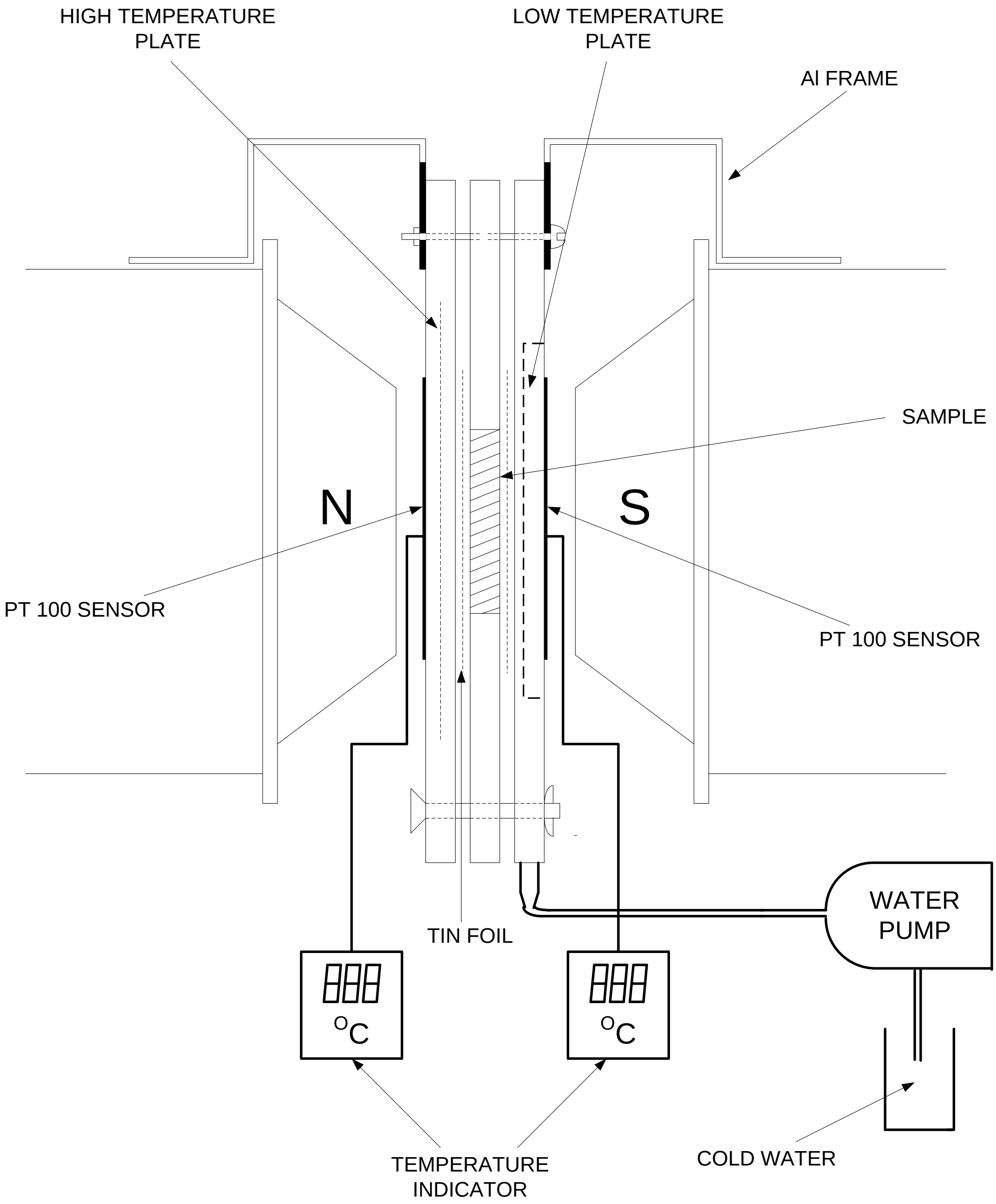

Figure 2

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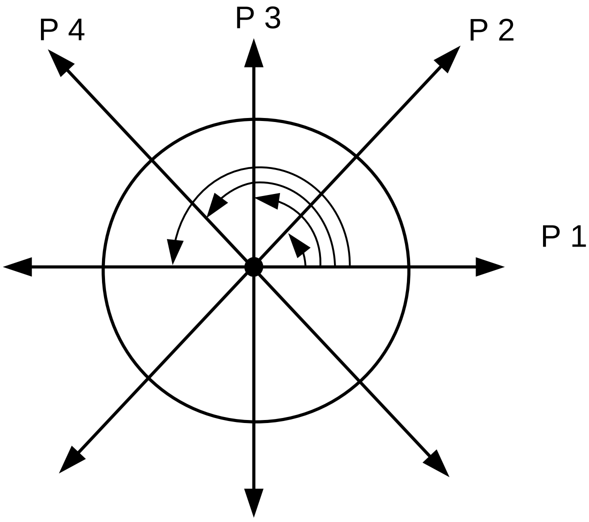

P 1 - 0^0 -180^0
P 2 - 45^0 -225^0
P 3 - 90^0 -270^0
P 4 - 135^0 -315^0

Figure 3

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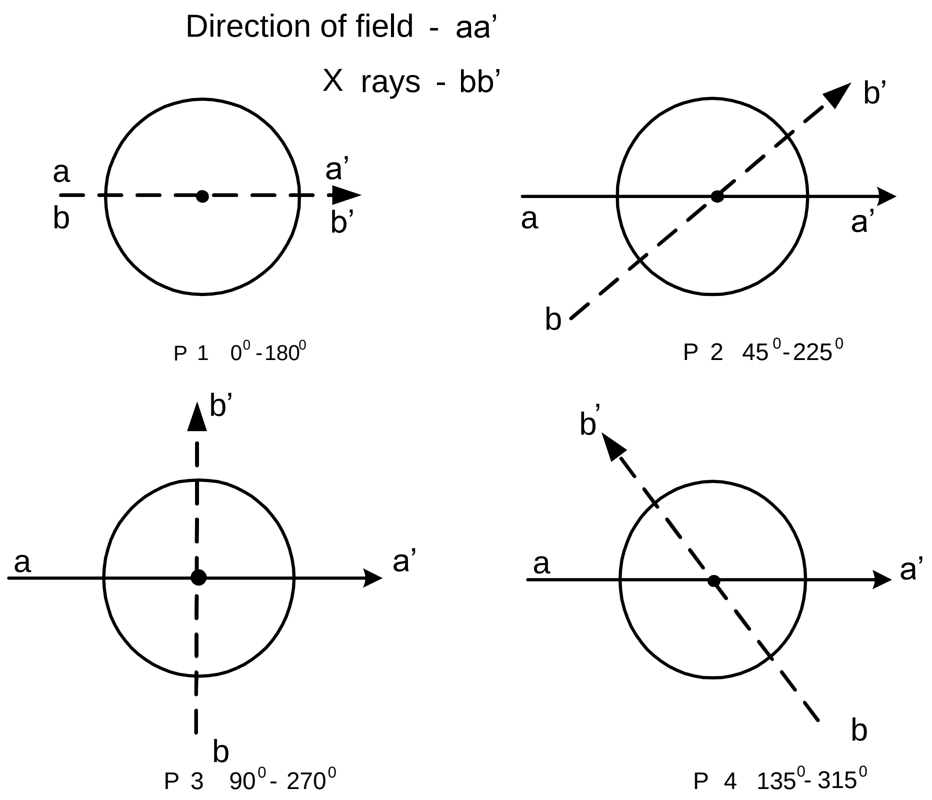
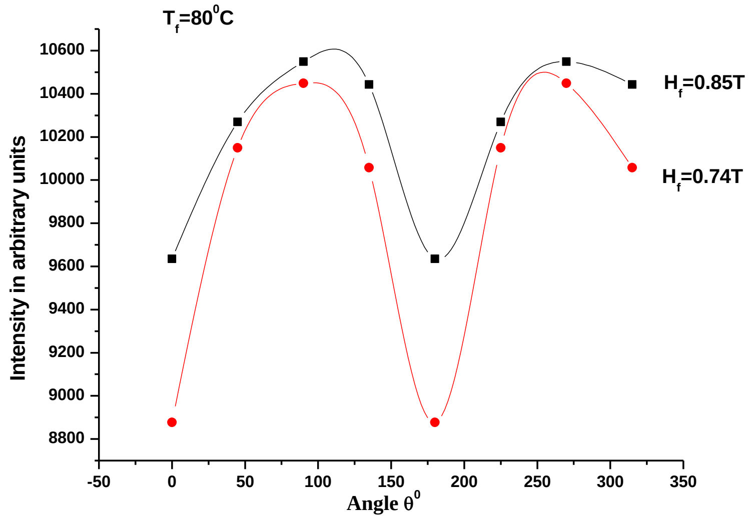
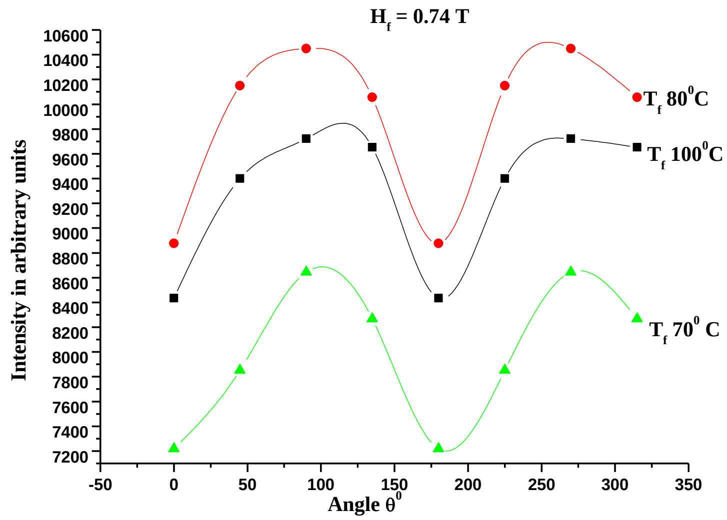


Figure 4



T_f=80^0C
H_f=0.85T
H_f=0.74T
Intensity in arbitrary units
Angle θ^0
10600
10400
10200
10000
9800
9600
9400
9200
9000
8800
-50
0
50
100
150
200
250
300
350

(a)



H_f = 0.74 T
T_f 80^0C
T_f 100^0C
T_f 70^0 C
Intensity in arbitrary units
Angle θ^0
10600
10400
10200
10000
9800
9600
9400
9200
9000
8800
8600
8400
8200
8000
7800
7600
7400
7200
-50
0
50
100
150
200
250
300
350

(b)

Figure 5