سامية محمد مصطفى

شبكة المعلومات الجامعية

بسم الله الرحمن الرحيم

سامية محمد مصطفى

شبكة المعلومات الجامعية

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التوثيق الالكتروني والميكروفيلم

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سامية محمد مصطفى

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات

يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار

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بعض الوثائق الأصلية تالفة

سامية محمد مصطفى

شبكة المعلومات الجامعية

بالرسالة صفحات لم ترد بالأصل

PROPERTIES OF HIGH TEMPERATURE SUPERCONDUCTORS IN THE MIXED STATE

THESIS

Submitted in Partial Fulfilment for the requirements for the Degree of Master in Science "Physics"

To

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Dedicated To

My Parents,
My Husband
and
My Daughter

ACKNOWLEDGMENT

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CONTENTS

SUMMARY

Summary

The behavior of superconductors in the presence of a magnetic field has been the subject of much scientific as well as practical, interest over the past few decades. On the practical side, the design and performance of superconducting magnets are often limited by the suppression of superconductivity in large magnetic fields. The behavior observed in various experiments on superconductor in a magnetic field is quite diverse, and its full elucidation is a substantial scientific challenge. Discovery of high-temperature superconductors has spurred a significant reexamination of this subject. These materials exhibit phenomena that were not detected in previously studied superconductors. They also have the potential to remain superconducting at much higher magnetic fields than earlier materials and thus may eventually allow the construction of higher field magnets.

The thesis is organized as follows:

Chapter 1 is devoted for a survey on the historical background of superconductivity, the discovery of high temperature superconductors and the effect of their layered structure on their magnetic properties.

Many authors treated the problem of the creation of closed vortex by a transport current in isotropic superconductors. In chapter 2 we extend this work for anisotropic superconductor when the field lies along the crystal axis. The magnetic field, the supercurrent and the free energy for an isolated vortex are investigated in an infinite superconductor (unbounded problem) and also for a superconductor of cylindrical shape (bounded problem). Similarly, as in the isotropic case, the results show that the free energy grows monotonically with r_s, the vortex radius, so the toroidal

vortex is unstable and tends to contract towards the z-axis. Due to the collapse the phase difference φ of the order parameter ψ, presents in going around the vortex line, disappears and induces a voltage from the relation $\frac{\delta\varphi}{\delta t} = 2ev/\hbar$. The occurrence and collapse of the vortex create a resistive state in the superconductor channels.

In our derivation for these properties if we put $\lambda_{ab}=\lambda_c=\lambda$ we return back to the isotropic case and this shows that our results are in good agreement with the available results.

The magnetic field and the free energy of a tilted Abrikosov vortex ring in a layered superconductor was studied. Two cases were considered in chapter 3.

(i) for $\xi_c<s$, the spacing layer, with weak Josephson coupling. Basic equation, developed within an approach to Lawrence-Doniach model for the vortex line, was used to study the free energy of the tilted vortex ring for 2D pancake model. The energy obtained is composed of two terms: the first is the free energy in the pure electromagnetic (2D pancake) model ($\lambda_c=\infty$), whereas other terms describe the effect of Josephson currents.

(ii) for $\xi_c>$ s. The magnetic field distribution was determined where the superconductor is considered as a 3D behavior. The comparison with the isotropic case can not be derived out since in layered superconductor the dependence on the direction of the vortex can not be omitted as in non-layered superconductor.

CHAPTER 1