بسم الله الرحمن الرحيم

شبكة المعلومـــــات الجامعية

التوثيق الالكتروني والميكروفيلم

شبكة المعلومات الجامعية

جامعة عين شمس

التوثيق الالكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها علي هذه الأفلام قد اعدت دون آية تغيرات

يجب أن

تحفظ هذه الأفلام بعيداً عن الغبار

في درجة حرارة من 15 – 20 مئوية ورطوبة نسبية من 20-40 %

To be kept away from dust in dry cool place of 15 – 25c and relative humidity 20-40 %

بعض الوثـــائق الأصليـة تـالفـــة

بالرسالة صفحات

لم ترد بالأصـــــل

AIN SHAMS UNIVERSITY

Faculty of Science

Department of Physics

" ION BEAM ANALYSIS AND ITS APPLICATIONS "

By

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ABSTRACT

The aim of this work is the analysis of the ion beam which is extracted from two types of electrostatic confined discharge ion sources, the cold cathode plane electrodes ion source and the hemispherical electrode confined discharge ion source. Experimental results are carried out using these ion sources. Ion beam applications are also achieved such as sputtering of the cathode and ion etching on the Faraday cup using different gases.

The experimental measurements are taken for a fixed geometry of the two types of these ion sources at different gas pressures. The discharge voltage, discharge current and output ion beam current for different gases are measured. It has been found that with the increase of the discharge voltage of the anode electrode, both the discharge current and output ion beam current increase.

Also measurements are taken by applying a negative voltage to the focusing electrode of the hemispherical electrode confined discharge ion source to study its effect on the output ion beam current at different discharge powers for pressures equal to $P=4.4x10^{-3}$ mmHg. and $P=5.8x10^{-3}$ mmHg using nitrogen and argon gases respectively. It is found that the relations between the focusing voltage and output ion beam current are linear for focusing voltage greater than about 500 volt.

The effect of variation of the voltage between the plasma boundary and the focusing electrode on the position of the plasma boundary has been given using the experimental results of the characteristics of the hemispherical electrode confined discharge ion source and its geometrical parameters. It is found that by increasing the potential to the focusing electrode, the plasma boundary takes a concave shape and this leads to bigger plasma boundary which results in a focused high ion current.

Photograph pictures showing plasma sputtering of the cathode, deposition of sputtered materials on the anode and ion beams etching on Faraday cup are given. These phenomena occur during the experimental operation using both cold cathode plane electrodes ion source and the hemispherical electrode confined discharge ion source.

The total rate of sputtering for both ion sources has been calculated using the discharge characteristics obtained from the experimental results such as discharge voltage, discharge current output ion beam current and pressure for argon, nitrogen, oxygen and helium gases.

A comparison is made for the total rate of sputtering of the two types of ion sources at constant pressure using different gases. It has been found that the total rate of sputtering is higher for a gas of higher mass number such as argon gas than that for a gas of lower mass number such as oxygen, nitrogen and helium gases.

Two types of electrostatic focusing systems have been studied, the first consists of two unipotential hemispherical electrodes and a plane earthed electrode placed between them while the second consists of five parallel plane electrodes. The two focusing systems have been designed according to the shape and dimensions of the electrodes used for the two types of electrostatic ion sources. The parameters which affect the shape of the ion beam profile inside and outside both the two focusing systems until they reach the target have been studied.

The shape of the beam profile of finite length has been investigated. It is found that the beam profile shape depends on the initial beam radius, beam perveance, atomic mass number of the gas used, charge state of ions and beam length. These parameters also affect the relation between the initial radius and the final one. An optimum initial beam radius corresponding to minimum final beam radius at the targets has been formulated and