International Journal of Engineering, Science and Mathematics
Vol. 5 Issue 1, March 2016,
ISSN: 2320-0294 Impact Factor: 6.765
Journal Homepage: http://www.ijesm.co.in, Email: ijesmj@gmail.com
Double-Blind Peer Reviewed Refereed Open Access International Journal - Included in the International Serial Directories Indexed & Listed at: Ulrich's Periodicals Directory ©, U.S.A., Open J-Gage as well as in Cabell's Directories of Publishing Opportunities, U.S.A

A TECHNIQUE FOR STUDYING PHASE TRANSITION USING A THYRATRON

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ABSTRACT:

In the present investigation a mercury vapour filled thyratron RCA- 884 has been chosen for studying the phase transition from gaseous phase to plasma state. By imparting different biases to the grid, cathode terminals the corresponding plate currents in thyratron worc measured. Further the input terminals were connected to an accurate capacitance and loss factor meassuring bridge. This in turn yields the computation of the real and imaginary components of the complex pernittivity. The negative values of the real part was obtained for high current values indicating a phase transition from gaseous state to a plasma state. The measurements were made in the frequency range upto 300 Khz, while the plate current densities were 0.5 ma, 1.0 ma, 4.0 ma and 8.0 ma.

KEYWORD : Frequency range,Plate Current densities,Cathode terminal,Complex permittivity,Plate Current.

INTRODUCTION :

In this universe the matter exists in four states. These are solid, liquid, gas and plasma. Further a bulk matter undergoes sudden and profound structural changes. Such changes are called phase transitions, the most familiar example of which is the melting of ice, a crystalling structure which changes at a precise temperatures into a structureless liquid. In the liquid 'Phase', there is absolutely no hint that this same substance-water-can assume a crystalline 'Phase' when it is closed. Other good examples of the phenomenon is that the magnets suddenly lose their magnetism when heated above a certain high temperature, but return to the magnetic state when cooled below that same temperature/1/.

EXPERIMENTAL TECHNIQUE:

In the present investigation a mercury vapour filled thyratorn (RCA- 884) has been choosen. The mercury vapours in the thyratron are in a gaseous phase and by application of

high currents, a transition into plasma state has been observed. The experimental technique consists in operation of a thyratron by allowing a high D.C. potential between filament and the plate and measuring the corresponding capacitance and lose factor of the mercury vapour filled medium between the grid and filament for different frequency values using a suitable measuring bridge. This permits computation of the real and imaginary components of the comples permittivity/2/. The experiment was conducted in the frequency range 100 KHz to 300 KHz under small regular frequency variation.

RESULT AND DISCUSSIONS:

For high plate current values the ionized gas behaves as a plasma which is confirmed by the decrease in the values of the dielectric constant below zero. That is negative values of the dielectric constant is obtained which confirmed to the phase transition of the mercury vapors into plasma state. The frequency versus the real part curves conformed to the relation given by duffin /3/

$$€' = 1 - \frac{n_* e^2}{€_0 \, m \, (\omega^2 + b^2)}$$

Where n is the number of charge carriers per unit volumes of the plasma, b,is one collision frequency, $€_0$ is the dielectric constantof the air and $€'$ are real part of the complex dielectric constant, ω the circular frequency.

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