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ECE – A

Physics: Electromagnetic Theory, Quantum Mechanics, Waves and Optics- 18PYB101J

EXPERIMENT- 4

21-05-2021

DETERMINATON OF PARAMAGNETIC SUSCEPTIBILITY QUINCKE'S METHOD.

AIM:

To measure the Suseptibility of paramagnetic Solution by Quincke's tube method.

APPARATUS REQUIRED:

Quincke's tube, Travelling microscope, Sample ($FeCl_3$ Solution), electromagnet, power supply, Gauss meter.

PRINCIPLE:

Based on molecular currents to explain Para and diamagnetic properties. magnetic moment to the molecule and such substances are attracted in a magnetic fields are called paramagnetic. The repulsion of diamagnetic is assigned to the induced molecular current and it's respective reverse magnetic moment.

The force acting on a substance, of either repulsion or attraction, can be measured with the help of accurate balance in case of solids or with the measurement of rise in level of narrow capillary in case of liquids.

The force depends on the susceptibility χ, of the material. i.e, on ratio of intensity of magnetization to magnetizing fields I/H. If the force on the substance and fields are measured then value of suceptibility can be calculated.

FORMULA:

The susceptibility of the given sample is found by the formula,

$$\chi = \frac{2(\rho - \sigma)gh}{H^2} \quad kg\ m^{-1} s^{-2}\ gauss^{-2}$$

where ρ is the density of the liquid or solution ($kg\ /m^3$)

σ is the density of air (kg/m^3)

g is the acceleration due to gravity (m/s^2)
h is the height through which the column rises (m)
H is the magnetic field at the centre of pole pieces (Gauss)

OBSERVATION:

ρ = density of the liquid or solution = 1490 kg/m^3

σ = density of air = 1 kg/m^3

For Travelling microscope,
Least Count = 0.001 cm
Microscopic reading without field (h_1) = 2.854 cm
TR = MSR + (VSC × LC).

CALCULATION:

MSR + (VSC × LC) = TR and $h \times 10^{-2}$ and h/H^2 =

1. TR = 2.95 + (2 × 0.001)
= 2.952 cm ; h = 0.02954 m ; H = 2200 ↓ $h/H^2 = 6.103 \times 10^{-9}$

2. TR = 3.00 + (21 × 0.001)
= 3.021 cm. ; h = 0.03021 m ; H = 2850 ↓ $h/H^2 = 3.719 \times 10^{-9}$

3. TR = 3.05 + (14 × 0.001)
= 3.064 cm ; h = 0.03064 m ; H = 3100 ↓ $h/H^2 = 3.189 \times 10^{-9}$

4. TR = 3.10 + (11 × 0.001)
= 3.111. ; h = 0.03111 m ; H = 3650 ↓ $h/H^2 = 2.335 \times 10^{-9}$

Mean $h/H^2 = 3.836 \times 10^{-9}$

RESULT:

The magnetic susceptibility of the given sample = 1.1200×10^{-4} kg $m^1 s^{-2}$ gauss^{-2}

DETERMINATION OF PARAMAGNETIC SUSCEPTIBILITY BY QUINCKE'S METHOD

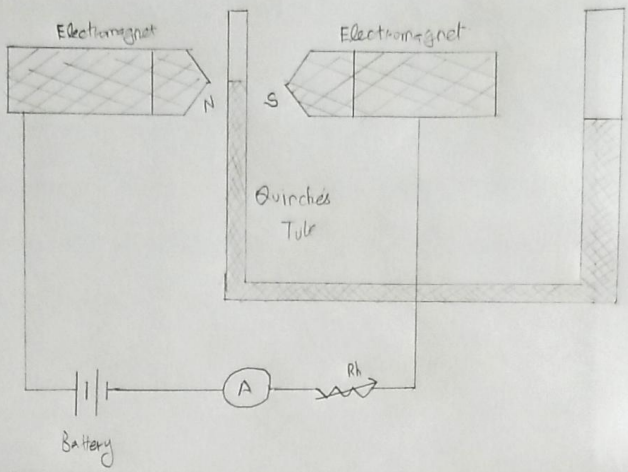

Table: To find the rise in the capillary tube of the solution

S.No	Current (i)	Field (H)	Travelling microscope Reading (h_1) cm			Difference $h = h_1 \sim h_2$	$\frac{h}{H^2}$
	Ampere	Gauss	MSR (cm)	VSC (div)	TR (cm)	$\times 10^{-2}$ m	(m^{-1})
1-	1	2200	2.95	2	2.952	0.02952	6.103×10^{-9}
2-	2	2850	3.00	21	3.021	0.03021	3.719×10^{-9}
3-	3	3100	3.05	14	3.064	0.03064	3.188×10^{-9}
4-	4	3650	3.10	11	3.111	0.03111	2.335×10^{-9}

Mean $\frac{h}{H^2} = 3.836 \times 10^{-9}$