

Original Article

Influence of magnesium doping on refractive index of sodium metasilicate gel using hollow glass prism

S. J. Baviskar

Department of Physics, Dr. Annasaheb G. D. Bendale, Mahila Mahavidyalaya (Autonomous), Jalgaon, India

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Correspondence Address:

S. J. Baviskar
Department of Physics, Dr.
Annasaheb G. D. Bendale, Mahila
Mahavidyalaya (Autonomous),
Jalgaon, India
Email- sjbaviskar07@gmail.com

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Abstract

The present study investigates the influence of magnesium doping on the refractive index of sodium metasilicate gel using a hollow glass prism and spectrometer. A sodium metasilicate solution was prepared using double-distilled water and subsequently treated under controlled acidic conditions. The refractive index of the prepared gel was measured for yellow spectral light at different time intervals at room temperature. The experimental observations show a progressive increase in the refractive index with time, rising from 1.3058 at 0 hours to 1.4153 after 120 hours. This increase indicates a corresponding change in the density and optical properties of the magnesium-doped sodium metasilicate gel during the observation period. The study demonstrates that the hollow prism-spectrometer method provides an effective approach for monitoring changes in the refractive index of the gel over time.

Keywords - Refractive index, sodium metasilicate gel.

Introduction

The refractive index is an important optical property used to characterize the behavior of a material when light passes through it. It depends on the physical and chemical characteristics of the medium and can vary with changes in composition, concentration, density, and time. The measurement of refractive index therefore provides useful information about changes occurring within solutions and gel-like materials. Sodium metasilicate is an important inorganic material that can form a semi-solid gel under suitable conditions. The optical properties of sodium metasilicate gel may change during the process of gel formation and with variations in its composition. The addition of magnesium as a dopant can further influence the physical properties of the gel and may produce measurable changes in its refractive index. In the present study, a hollow glass prism coupled with a spectrometer is employed to determine the refractive index of magnesium-doped sodium metasilicate gel. The refractive index is measured for the yellow spectral line at different time intervals under room-temperature conditions. The variation in refractive index with time is studied to understand the relationship between the changing density and optical behavior of the gel. This approach provides a simple experimental method for investigating the optical characteristics of magnesium-doped sodium metasilicate gel.

Methodology

Sodium metasilicate gel was prepared using double-distilled water and sodium metasilicate powder. For the preparation, 20 g of sodium metasilicate was dissolved in 250 cc of double-distilled water. The solution was thoroughly stirred and subsequently filtered through filter paper to obtain a uniform mixture. The prepared solution was transferred into an airtight container for further treatment. To obtain the required gel condition, 5 cc of 2 N acetic acid was added to 100 cc of the prepared sodium metasilicate solution. The pH was monitored using a digital pH meter, and the treatment was continued until a pH of approximately 4.3 was achieved. The prepared gel was then allowed to develop under controlled room-temperature conditions. The refractive index of the magnesium-doped sodium metasilicate gel was measured using a spectrometer and a hollow glass prism. Before measurement, the telescope eyepiece was focused carefully on the cross-wire. The hollow prism containing the sample was positioned on the prism table and adjusted for the yellow spectral line produced by a mercury light source. The prism table was maintained in a fixed position throughout the observations. The telescope was then adjusted using the fine-motion screw so that the intersection of the cross-wire coincided with the yellow spectral line, after which the corresponding Vernier readings were recorded. Refractive-index measurements were taken at different time intervals, beginning at 0 hours and continuing up to 120 hours. The change in refractive index with time was used to evaluate the variation in the optical properties of the gel as its density increased during the observation period.

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Result and Discussion**Result Table**

Obs. No.	Time in hours	Refractive index for Yellow color
1	00:00	1.3058
2	24:00	1.3298
3	48:00	1.3432
4	72:00	1.3511
5	96:00	1.3893
6	120:00	1.4153

Conclusions

The present study demonstrates that magnesium doping has a noticeable influence on the refractive index of sodium metasilicate gel. The refractive index measured using a hollow glass prism and spectrometer showed a continuous increase with time, rising from 1.3058 at 0 hours to 1.4153 at 120 hours. This progressive change indicates that the optical properties of the gel are closely associated with its structural development and increasing density during the observation period. The results confirm that the hollow prism–spectrometer method provides a simple and effective approach for monitoring refractive-index variations in sodium metasilicate gel.

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Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper

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