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# THERMALLY AND DEFORMATION INDUCED FLUORESCENCE IN SODIUM IODIDE

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The present paper reports the excitation and emission spectra of sodium iodide phosphor in three different physical conditions namely (i) as-received powder form, (ii) thermally treated NaI powder condition and (iii) NaI tableted condition. The fluorescence spectra have been recorded by means of Aminco-Bowman spectrophoto-fluorometer supplied by American Instrument Co. Inc. The examination of fluorescence spectra in different physical conditions of NaI phosphor reveals the fact that fluorescence spectra are found significantly influenced by pretreatments. It is presumed that the change in density of vacancy, vacancy pair and dislocation in lattice of NaI on application of pre-treatments is responsible for the observed change in fluorescence spectra of NaI in different physical conditions.

## Introduction

The progress made in the field of luminescence of solids has been known for a long time. Nowadays the phenomenon of luminescence is one of the important branches of solid state physics in the present scientific world. Luminescence materials are used in a variety of applications like medicine, agriculture, radiation applications, archaeological and geological dating, etc. The luminescence from alkalihalides has been found very interesting and useful in different fields. Luminescence of alkalihalides, particularly iodides [1–3] has been studied extensively. However, the survey of literature indicates that there is no systematic study of sodium iodide (NaI). Therefore, the present paper reports the fluorescence spectra of pure NaI in different physical conditions.

## Experimental

This paper discusses the effect of different physical treatments on the fluorescence spectra of sodium iodide (NaI). The specimens were prepared by the method of recrystallization from aqueous solution. They were subjected to thermal and/or mechanical pretreatments. The NaI material was examined for its luminescent behaviours in the following physical conditions:

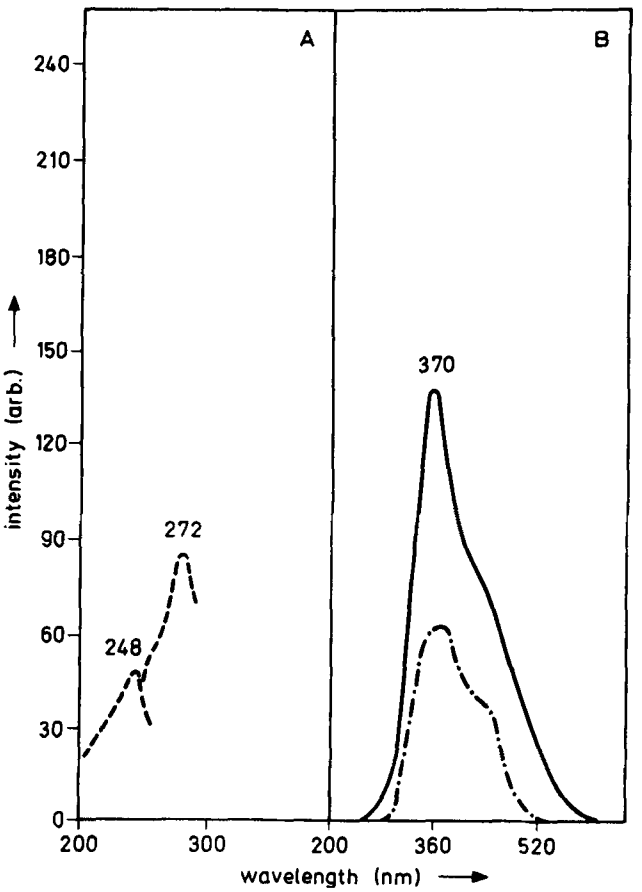


*Fig. 1.* Fluorescence spectra of NaI powder: in as-received condition; A – excitation spectra, B – emission spectra

(i) As-obtained NaI powder obtained from aqueous solution through recrystallization.
(ii) As-obtained NaI, annealed and rapidly cooled to room temperature from 500 °C in open air.
(iii) NaI pellet obtained from as-obtained material through plastic deformation.
(iv) NaI tablet prepared from 500 °C air-quenched powder through mechanical compression.

The emission and excitation spectra were recorded for the above mentioned specimens at room temperature under identical experimental conditions. The instrument used to study the excitation and emission spectra is Aminco-Bowmann spectrophoto-fluorometer supplied by American Instrument Co. Inc. Sodium iodide

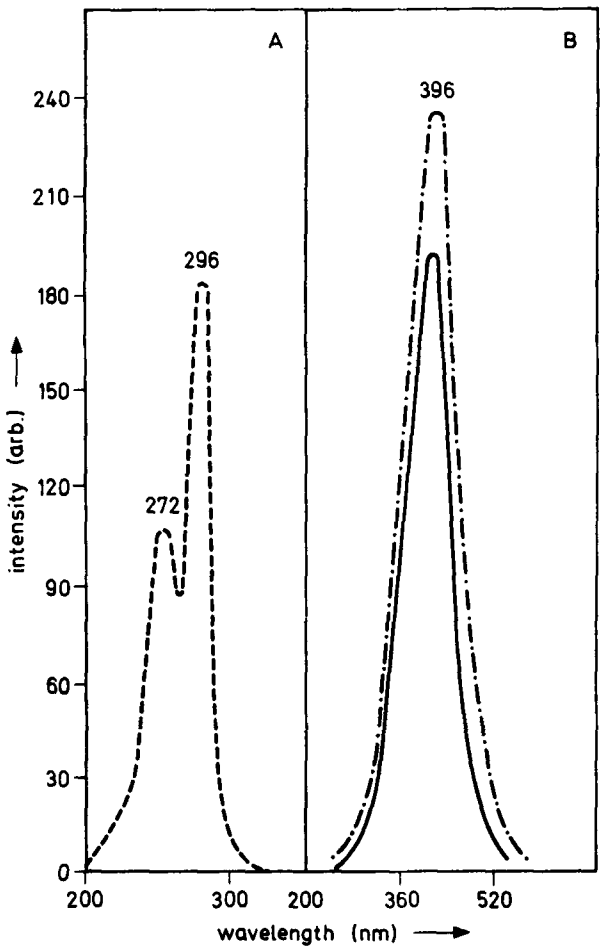


*Fig. 2.* Fluorescence spectra of NaI powder after annealed at 500 °C and then cooled to room temperature in air; A – excitation spectra, B – emission spectra

in powder form used in the present work was supplied by 'Loba Chemi Wien–Fischamed Austramal–Preparate' Company.

In all cases, the excitation spectrum of a given specimen was first observed and subsequently its emission spectrum stimulated by observed excitation was recorded. Each excitation and emission band is specified by the wavelength at which its peak appears.

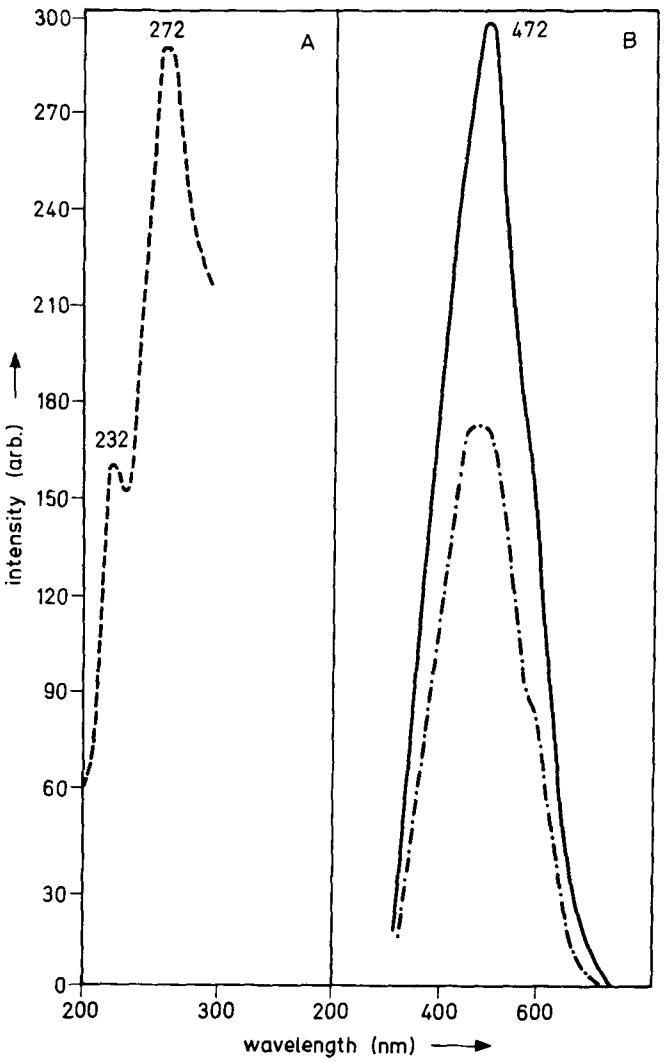


*Fig. 3.* Fluorescence spectra of NaI pellet, obtained from as-received NaI powder; A – excitation spectra, B – emission spectra

## Results and discussion

The fluorescence characteristics exhibited by sodium iodide in different physical conditions are as follows:

(i) Untreated NaI phosphor exhibits two excitation bands at 248 and 272 nm. These excitation bands produce dominant emission around 370 nm along with a hump at 460 nm (Fig. 1).

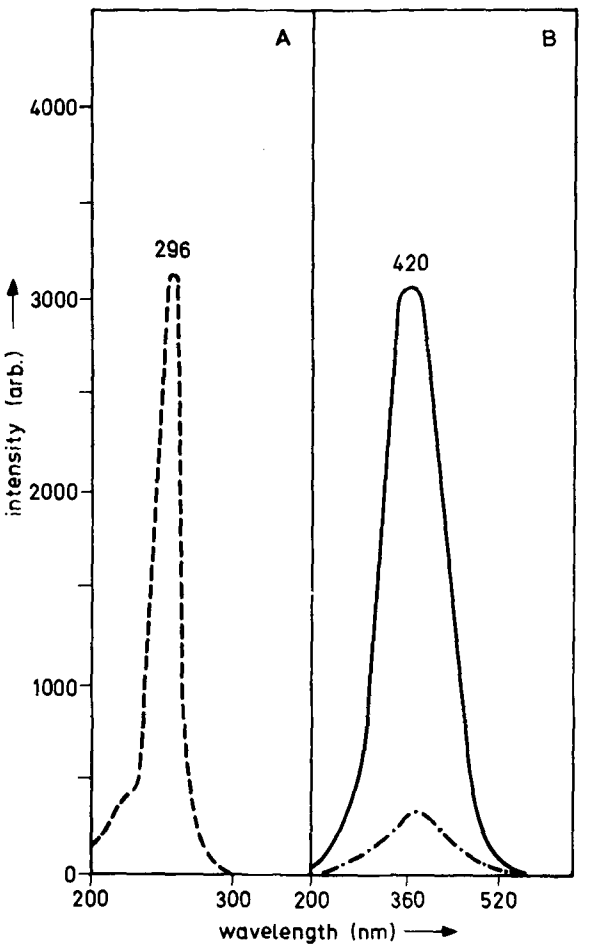


*Fig. 4.* Fluorescence spectra of NaI pellet obtained from the powder annealed at 500 °C, then cooled to room temperature in air, A – excitation spectra, B – emission spectra

(ii) The fluorescence spectra displayed by NaI phosphor are found sensitive to thermal treatment. The main emission, 370 nm, shifts towards the higher wavelength side, i.e. to 396 nm on execution of pre-heat-treatment. The overall intensity of the fluorescence spectrum also increases with thermal treatments. The corresponding excitation wavelengths are 272 and 296 nm (Fig. 2).

(iii) Like pre-heat-treatment, mechanical pre-treatment also enhances the overall intensity of luminescence and shifts the dominant emission band on the higher wavelength side (Figs 3 and 4).

(iv) It is very clearly found that the pellet of 500 °C air quenched NaI material exhibits optimum fluorescence output among the specimens under examination.

It is believed that the emission band exhibited by pure NaI powder may be associated with the crystallinity of the material or an inherent metallic impurity present in the phosphor. The change in fluorescence behaviours of NaI specimens on application of thermal and/or mechanical treatment may be on account of the change in density of point defect, migration of point defects, and diffusion of an inherently present impurity in NaI material. It is quite obvious that the concentration of point defect and dislocation density is high in pretreated specimens due to thermal or mechanical shock. This new situation is responsible for the high fluorescence output and other changes in fluoresecence spectra of NaI in the thermally and/or mechanically treated specimens.

## References

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