spherical structures even though the latter have the minimal surface area.

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RESEARCH COMMUNICATIONS

Preparation of polypyrrole thin films by RF plasma polymerization

Ligy Cherian and P. Radhakrishnan

Department of Physics, Cochin University of Science and Technology, Cochin 682022, India

Doped polypyrrole is a conducting polymer. Polypyrrole films are usually prepared by electrochemical methods. Here we report the deposition of polypyrrole thin films on glass substrates using the RF plasma polymerization method and its optical characterization. We also show that the optical band gap of polypyrrole films decreases from 2.8 eV to 0.8 eV as a result of iodine doping.

CONDUCTING polymers are a class of materials, which while exhibiting characteristic features of polymers like light weight, great workability etc., also offer properties such as strength, elasticity, toughness, conductivity, etc. comparable to those of metals. Polypyrrole has a large band gap (3 eV). The band gap can be reduced by incorporating proper dopants like iodine. It has been reported that thin films of polypyrrole find applications in electro-optic devices[1]. These films have also been tested as coatings for gallium arsenide (GaAs) and silicon semiconductor electrodes.

Using the RF plasma polymerization method highly crosslinked, pinhole-free, ultrathin polymeric films have been prepared from a large number of organic and organometallic monomers[2]. This method is more economical due to the optimum use of monomer, high efficiency of polymerization and the absence of any type of catalyst. The experimental set-up used for film deposition (Figure 1) consisted of a deposition chamber made of borosilicate glass tube, a pumping system with associated pressure-measuring equipment, and an RF power supply designed to oscillate at 4.5 MHz with a maximum output of 35 W. The energy from RF power supply was capacitively coupled to the plasma by aluminium foils wrapped around the tube. The plasma current can be varied over the range 30–90 mA.

Clean, dry glass substrates were loaded in the deposition chamber and the system evacuated to a pressure of 5×10^{-2} torr up to the monomer container. The monomer vapour was then admitted into the chamber by opening the stopcock. When the pressure inside the chamber became steady (10^{-1} torr), the power source was switched on. Current and voltage were adjusted to get a fairly good uniform discharge. The monomer gets polymerized and deposits on the substrate. Freshly prepared polypyrrole films were doped with iodine by keeping the thin films in a glass chamber (20 cm length × 5 cm diameter) containing iodine vapour for about 10–15 min.

The absorption spectra of pyrrole monomer (Figure 2,*a*), polymerized pyrrole (Figure 2,*b*) and iodine-doped polypyrrole (Figure 2,*c*) were charted using a UV–VIS–NIR spectrophotometer (Hitachi 330 model) in the wavelength range 400–1200 nm. The spectrum of polypyrrole (Figure 2,*b*) is similar to that reported in literature[3]. The absence of the characteristic monomer bands in the polypyrrole spectrum shows that the monomer was polymerized. From this spectrum the band gap of the sample was determined to be approximately 2.8 eV. The observed increase in absorption for the doped sample was due to the incorporation of iodine into the polymer structure. The band gap of the doped sample determined using the spectrum was approximately 0.8 eV. In the present investigation, iodine-doped polypyrrole thin films were found to be stable to a great extent. The absorption spectrum and the approximate

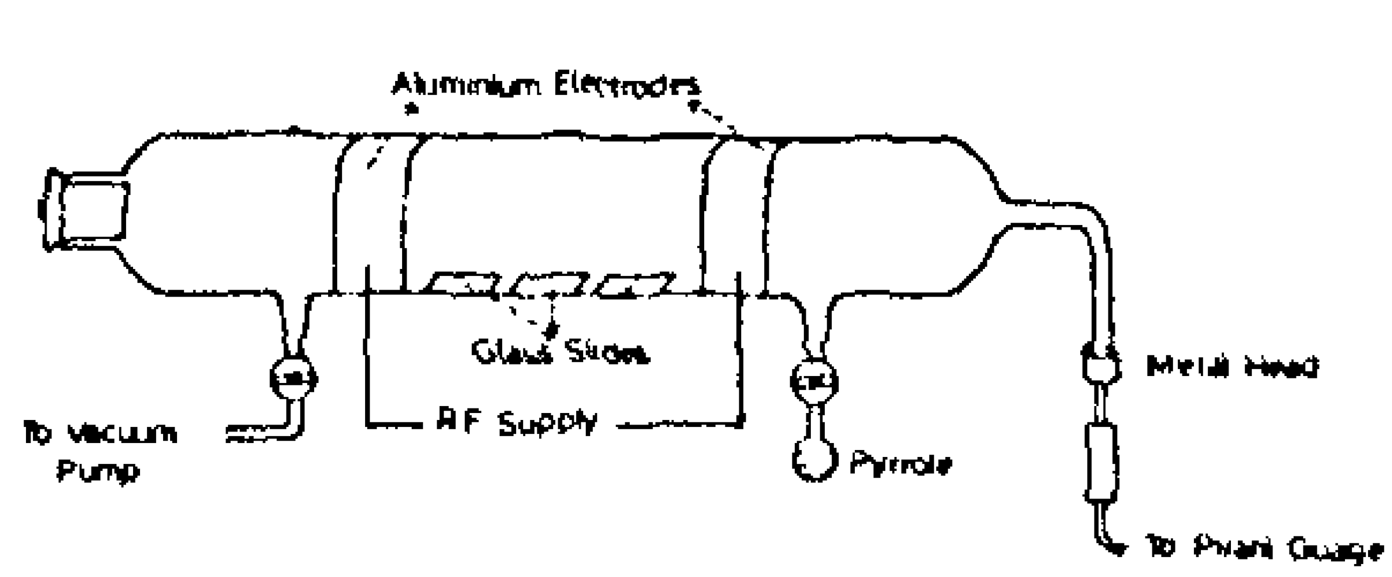
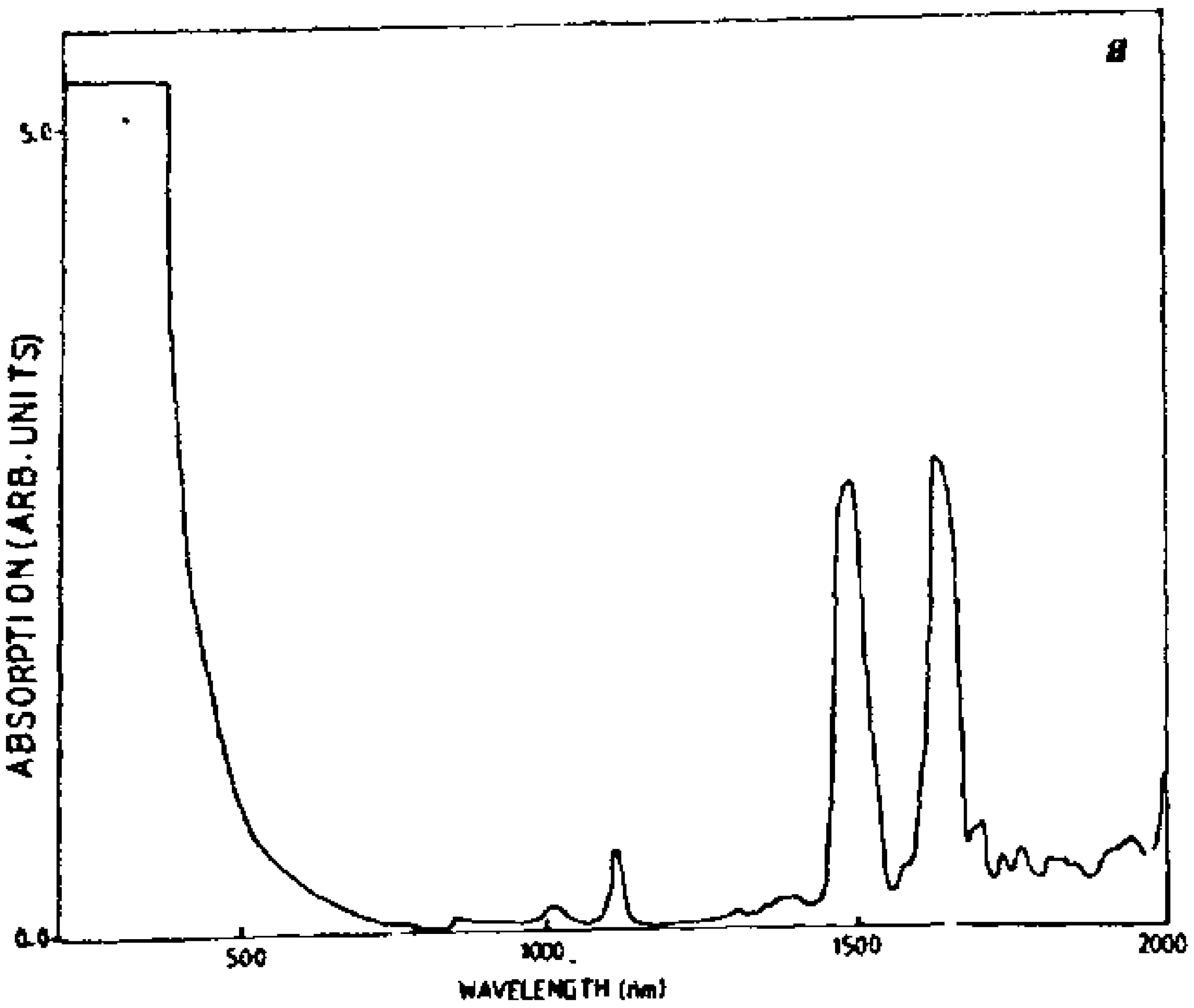
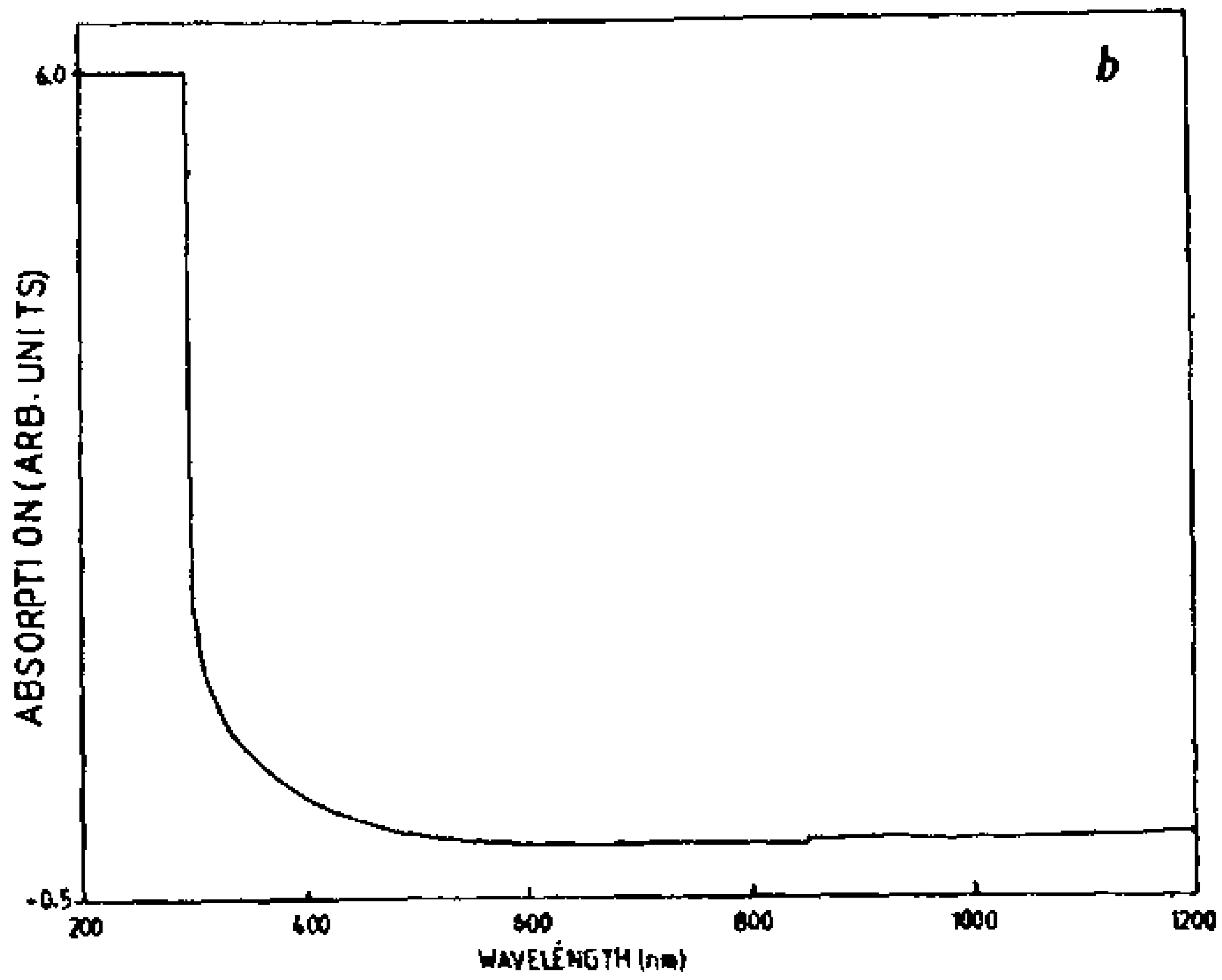


Figure 1. RF plasma polymerization set-up.





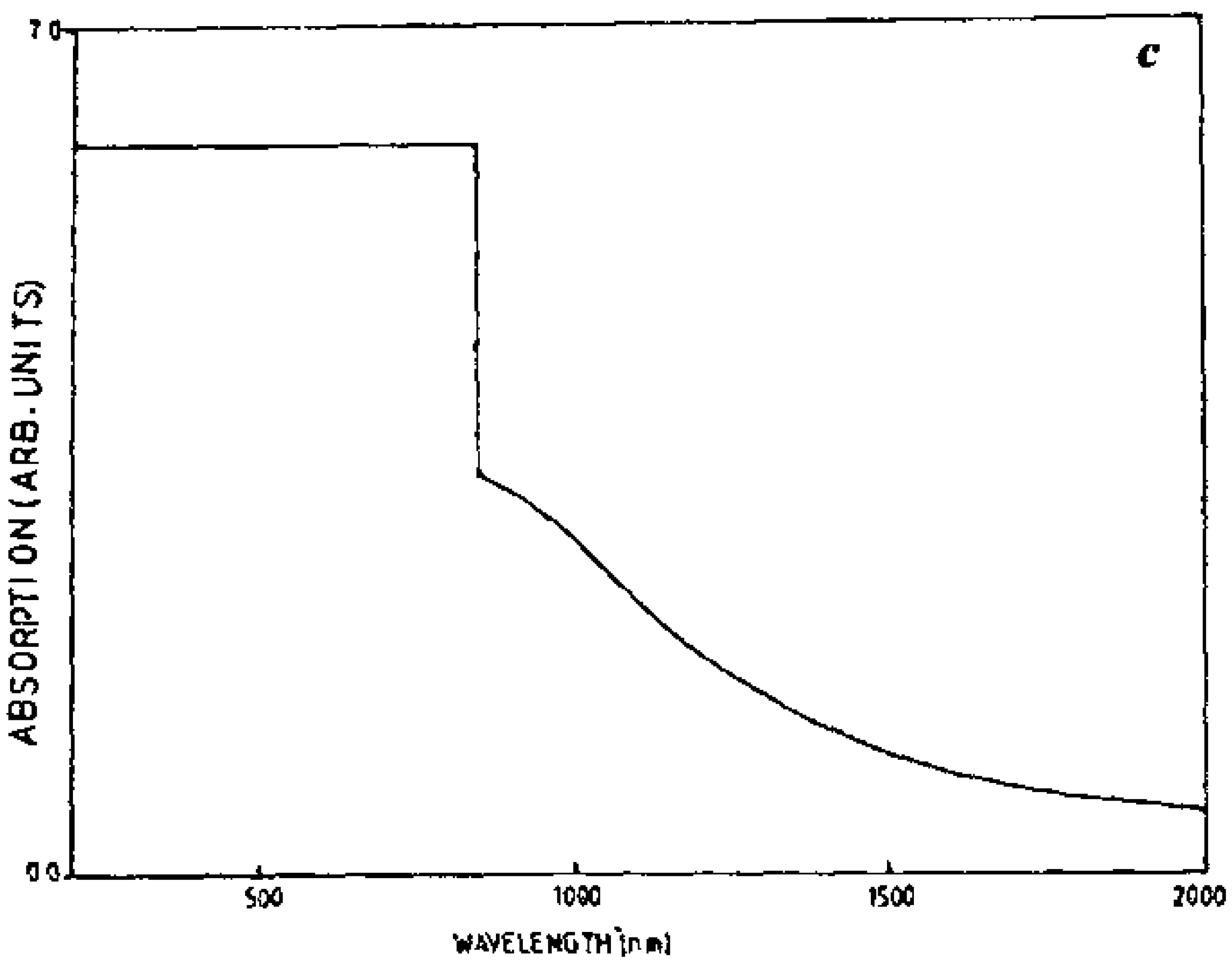


Figure 2. Absorption spectrum of *a*, pyrrole monomer; *b*, polypyrrole; *c*, iodine-doped polypyrrole.

value of the band gap determined from the spectrum did not show appreciable variation with ageing. With increase in dopant concentration, the band gap of the samples decreased. Preliminary studies on the conductivity of the doped sample support the conclusions of spectral studies. It was observed that the resistance of the sample decreased with increase in temperature, yielding a negative temperature coefficient of resistance.

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Petrography and geochemistry of the Miocene Limestone of Saurashtra, Gujarat, West India

Arun Kumar, Pratul K. Saraswati and S. V. Navada*

Department of Earth Sciences, Indian Institute of Technology, Bombay 400 076, India
*Isotope Division, Bhabha Atomic Research Centre, Bombay 400 085, India

Petrographically, the carbonate rocks of Saurashtra are of four major types, viz. foraminiferal wackestone, molluscan wackestone, foraminiferal packstone and algal foraminiferal packstone. Geochemical and stable-isotope analysis of these rocks indicates low strontium, high manganese and depletion in $\delta^{18}O$. We suggest that these are the effect of diagenetic alteration.

THE coastal regions of Saurashtra, fringed by the Deccan Trap and the Miliolite Limestone, has isolated