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THERMAL NEUTRON CAPTURE GAMMA RAYS FROM $^{141}Pr(n, \gamma)^{142}Pr$ REACTION

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ABSTRACT

Thermal neutron capture gamma rays from the product necleos ^{142}Pr were investigated in the $0 \sim 900$ keV range with a scintillation spectrometer coupled to a 400 channel analyzer at the 'CIRUS' reactor of Bhabha Atomic Research Centre, India. The energies and relative intensities of the observed gamma components were estimated and discussed.

THE nucleus $^{142}_{59}Pr_{83}$ is an odd-odd isotope with nine protons and one neutron outside the doubly magic ^{132}Sn core. The levels excited in such nuclides may be described in the framework of the nuclear shell model and the residual interaction between the last proton and the last neutron. The level structure of ^{142}Pr can be known only from reaction spectroscopy since the ground states of both the neighbouring isobars ^{142}Ce and ^{142}Nd are stable.

The present work on the $^{141}Pr(n, \gamma)^{142}Pr$ reaction was carried out at the 'CIRUS' reactor of Bhabha Atomic Research Centre, Bombay. The energies and relative intensities of gamma rays (in the range $0 \sim 900$ keV) were computed using a scintillation spectrometer and a 400 channel analyzer. The experimental technique comprising the reactor shielding arrangement, the target assembly and the electronic instrumentation were described in the earlier works[1,2]. The standardization, data collection and method of analysis were also given in the same references.

EXPERIMENTATION AND RESULTS

For the present investigation specpure praseodymium in the powdered form of Pr_6O_{11} was obtained from the Pure Material Section of the Chemistry Division of Bhabha Atomic Research Centre. The target was prepared in the form of a cylinder of dia 6 mm and length 12 mm. The $n\sigma$ value of the same corresponds to 0·109 (Radiative capture cross-section of praseodymium is 11·2 barns). Thermal neutron flux at the target position was estimated to be of the order of 10^6 neutrons/cm^2/sec, by Gold foil irradiation method.

The gamma ray detection was accomplished by a 38×38 mm NaI(Tl) crystal and the spectrum was scanned with the aid of a 400 channel analyzer. The observed gamma spectrum is shown in Fig. 1. There are eleven lines including the one due to annihilation quanta (A) at 511 keV. The energies of different gamma components are estimated and given in Table I. To determine the relative intensities of the different transitions, the peeling off technique was employed. Corrections due to self-absorption in the target, photopeak efficiency and absorption in $^6Li_2Co_3$ screen that protected

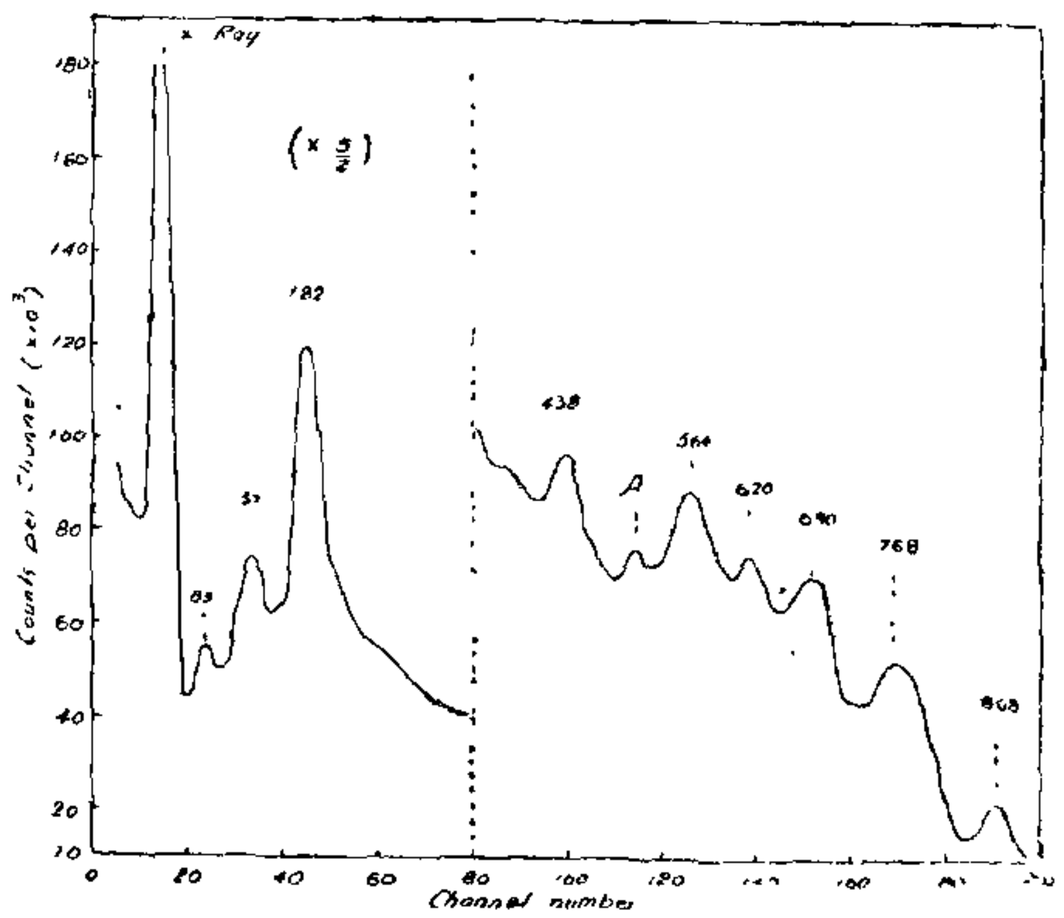

FIG. 1. Capture gamma ray spectrum from ^{142}Pr (below ~ 900 keV).

TABLE I

Low energy capture gamma rays from ^{142}Pr (A comparative data due to other authors with similar experimental systems as in the present work)

Present work		Giannini *et al.*[3]	
E_γ (keV)	I_γ (rel)	E_γ (keV)	I_γ
85 (3)	32 (4)	94 (2)	3
137 (3)	46 (4)	145 (3)	14
182 (3)	100 (5)	177 (3)	18
438m	16 (2)		
511 (4) (A)	23 (3)		
564m	60 (4)		
620 (5)	62 (5)		
690m	78 (5)		
768m	89 (7)		
868 (7)	40 (5)		

'm' indicates multiplet. The figures in brackets for E_γ and I_γ (rel) represent the errors for the energy and intensity determinations.

the detector from neutron irradiation were computed and applied to the observed gamma intensities. The 182 keV transition was found to be the strongest one and intensities of the other components were expressed relative to this. These results are summarized in Table I. For a comparison, the results of Giannini *et al.*[3], who used a similar experimental method for low energy gamma rays, are also included in the same table. However, the region of interest in ref. (3) confines only to a few transitions. Some of the lines observed in this work and interpreted as multiplets are indicated by '*m*' in Table I. The present measurements are in accordance with those due to the other experimental methods[4].

Discussion

The ground state spin[5] of the target nucleus ^{141}Pr is 5/2+ while that of the product nucleus[6] is 2⁻. The capture of a *s*-wave neutron will result in the formation of the initial state of ^{142}Pr with a spin-parity of either 3+ or 2+. In this situation, primary gamma rays of pure E1 type are expected to populate the low lying levels due to the decay of the capture state in $^{142}_{59}Pr_{83}$. The 83rd neutron has a spin-parity 7/2⁻ which in the shell model classification is characterised by the $(\nu f_{7/2})$ configuration. The odd proton (59th) may be expected to occupy the $(\pi d_{5/2}')$ configuration. In the shell model description, one expects a formation of six states from $(\pi d_{5/2}' \; \nu f_{7/2}')$ configuration mixing with spins 1 to 6 and negative parities. From the energy systematics of odd-odd nuclei[6], the present gamma components with energies 85, 137 and 182 keV may be regarded as those due to the transitions taking place between the corresponding states and the ground state of ^{142}Pr. The other components may be ascribed to the transitions taking place in the multiplets formed by configuration mixing of orbitals describing the ground and first excited states.

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NIOBIUM(V) COMPLEXES WITH AROMATIC SCHIFF BASES

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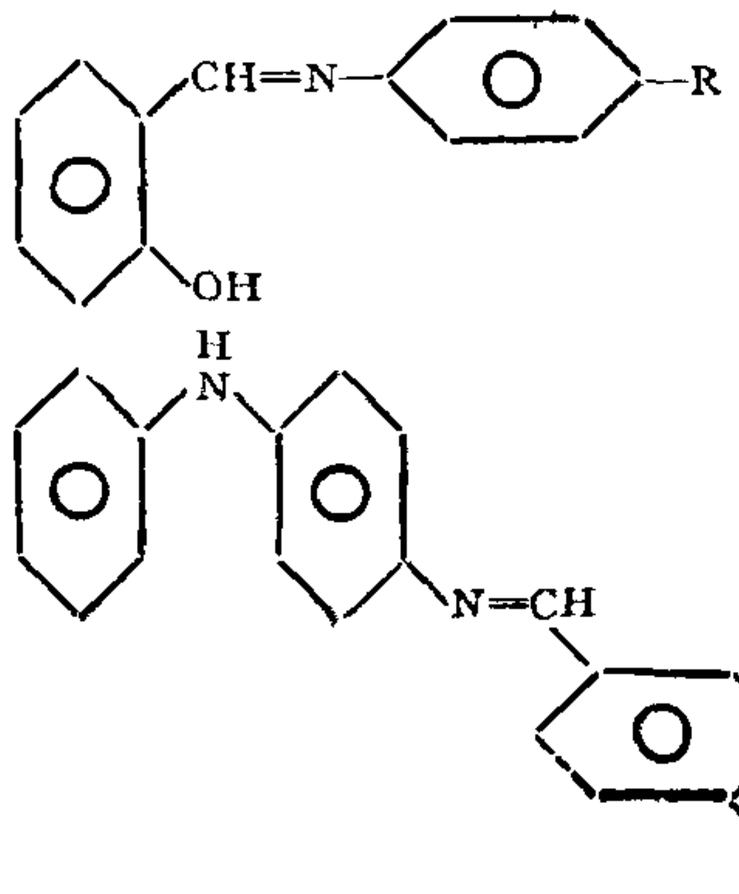
Abstract

Six niobium(V) complexes with aromatic Schiff bases have been prepared in chloroform and characterised by elemental analysis. These are non-electrolytes in DMF. Infrared spectra have been reported and all the complexes are regarded to have coordination a number of seven.

Introduction

THE complexes of niobium(V) with wide range of Schiff bases containing a variety of donor sites have been reported in the literature[1-4]. They have shown that in almost all the complexes the coordination number of niobium is seven. Prashar and Tandon[5] have recently reported hexa- and octa-coordinate Schiff base complexes of niobium (V) and tantalum (V).

This report concerns the synthesis and spectral studies of niobium(V) complexes with the following Schiff bases,



	R
I	H
II	Cl
III	$-CH_3$
IV	$-OCH_3$

	R'
V	H
VI	OCH_3

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