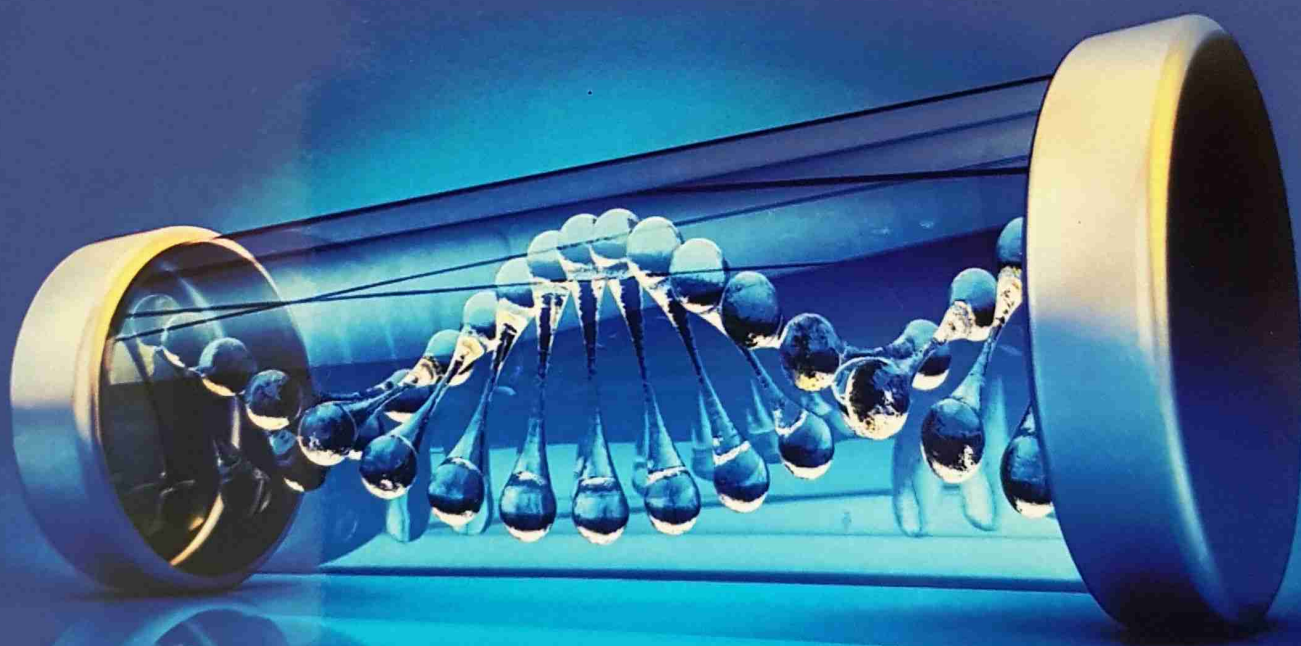


P.L. Soni  
Vandna Soni

# THE CHEMISTRY OF COORDINATION COMPLEXES



# TRANSITION METALS



Manakin  
PRESS

# **The Chemistry of Coordination Complexes and Transition Metals**

**Dr. P.L. Soni**

*Formerly Associate Professor in Chemistry,  
ARSD College,  
University of Delhi*

**Dr. Vandna Soni**

*Assistant Professor in Chemistry,  
Maharaja Agrasen College,  
University of Delhi*



**Manakin Press**

**Coordination Chemistry**  
P.L. Soni and Vandna Soni

© Manakin Press Pvt. Ltd., 2019

*Published by*

**Manakin Press Pvt. Ltd.**

B-300, Okhla Industrial Area, Phase-I

New Delhi-110020, India

Tel.: +91-11-45328300

Email: publisher@manakinpress.com

Website: www.manakinpress.com

For customer services and information, please email on info@manakinpress.com.

For our editorial support and about how to apply for permission to reuse the copyright material in this book, please email on publisher@manakinpress.com

**Disclaimer:**

Please be informed that the author and the publisher have put in their best efforts in producing this book. Every care has been taken to ensure the accuracy of the contents. However, the author and publisher make no representation or warranties of any kind and therefore shall not be responsible or liable to any person or entity with respect to any error, loss or incidental or consequential commercial damages accruing thereof. Neither the publisher nor the author is engaged in providing services of any professional nature and shall therefore not be responsible for any incidental, consequential, special or any other damages. Please do consult a professional where appropriate.

All due diligence has been taken by author/s, editor/s & publisher with regards to copyright but still if any then it one comes across and feels that a copyright infringement has taken place, which might have happened unknowingly should be notified at publisher@manakinpress.com so that immediate remedial measure can be taken.

---

No part of this work may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, microfilming, recording or otherwise, in permanent or temporary form without written permission from the publisher, with the exception of any material supplied specifically by the publisher for the purpose of being entered and executed on a computer system, for exclusive use by the purchaser of the work.

---

ISBN: 978-81-93877-20-3

Printed at: Avantika Printers Pvt. Ltd., Delhi

# Brief Contents

## Part-I: Coordination Chemistry

1. History of Complexes	3
2. Introduction	7
3. Correct Empirical Formula of Complexes	23
4. IUPAC System of Nomenclature	33
5. Isomerism and Stereochemistry	43
6. Bonding in Complexes	61
7. Preparation and Isolation of Complexes	91
8. Stability of Complex Ion	97
9. Kinetics of Inert and Labile Complexes	103
10. Substitution Reactions in Complexes	111
11. Coordination Complexes and Biological Systems	121
12. Uses and Applications of Coordination Complexes	143
13. Metal Carbonyls and Nitrosyls	173
14. Organometallics	<b>201</b>

## Part-II: Transition Metal Chemistry

1. General Characteristics of d-block Elements	229
--	-----

2. Titanium Group	255
3. Vanadium Group	261
4. Chromium Group	269
5. The Cobalt Group	305
6. The Zinc Group	331
7. Inner Transition or f-block Elements: The Lanthanides	345
8. The Actinides	359
<b>Bibliophile</b>	<b>371</b>
<b>Index</b>	<b>375</b>

**ABOUT THE BOOK**

This book is divided in two volumes. Volume-1 covers all important nomenclature, theories of bonding and stereochemistry of coordination complexes. The authors have made an effort to inscribe the ideas knowledge, clearly and in an interesting way to benefit the readers. The complexities of Molecular Orbital theory have been explained in a very simple and easy manner.

The second volume deals with transition and inner transition metals. It gives practical shape to the theories and ideas expressed in Part-1. Conceptually, all transition and inner transition elements form complexes which have definite geometry and show interesting properties. General and specific methods of preparation, physical and chemical properties of each element has been discussed at length. Group wise study of elements in d-block series have been explained. Important compounds, complexes and organometallic compounds of metals in different oxidation states have been given explicitly.

The study of lanthanides and actinides has been covered extensively. General characteristics, physical and chemical properties have been explained in detail. Block wise study of elements is taken up so as to convey every minute detail. Important compounds of different oxidation states have been discussed along with their uses. In 5f-block actinides, preparation of transuranium elements, separation of metals from one another and the last set of element has been detailed adequately. Care has been taken to cover all the important aspects. The elements which are yet to be discovered have been listed and their stability explained. Comparison between the properties of lanthanides and actinides has been clearly spelt out.

This book will strengthen the conceptual and explanatory approach of the readers and complete the circle of knowledge regarding the coordination complexes and transition metals.

**ABOUT THE AUTHORS**

**Dr. PL Soni** completed his post-graduation in chemistry in the year 1965 from the Panjab University, Chandigarh under the guidance of Dr. RC Paul. He had a brief stint of two years as a teacher in S.D. College, Ambala Cantt. In the year 1968 he joined ARSD College, University of Delhi as a Lecturer. He was awarded doctorate degree in inorganic chemistry in the year 1980 under the guidance of Professor B.S. Garg, University of Delhi. He served ARSD College for 40 years and held many important, prestigious and responsible positions. He was selected as subject expert by NCERT in 1977-78, and was a member of CBSE syllabus forming committee. He has given lectures and talks on Doordarshan several times. After retirement in 2004 he remained as Director GTBIT, IP University. Besides, he remained subject expert on several selection committees for schools, degree and engineering colleges. He was also on the panel of SSC, Government of India. He served as Professor in PDM College of Engineering, Bahadurgarh and a consultant to Quality Chemicals, Delhi. After retirement he is still in love with the subject and serving vast students community by disseminating knowledge through his books and writings.

**Dr. Vandna Soni**, Ph.D. from IIT Delhi, has been teaching at Maharaja Agrasen College, University of Delhi as Assistant Professor for over a decade. She has been constantly developing e-content and e-labs for undergraduate courses for DU Portal. She was deputed to Institute of Life Long Learning, University of Delhi as Fellow in Chemistry in 2009-10 to develop chemistry e-content, e-labs and value addition content for B.Sc. (H) and B.Sc. Programme. She has contributed as author for CBSE-I curriculum and content design. She has been involved in interdisciplinary undergraduate research projects founded by University of Delhi under Innovation scheme and star innovation scheme. Besides, she has been contributing towards development of e-content for Post-graduate courses in e-PG Pathshala project founded by MHRD.