IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 12, Issue 4, December 2021
Impact Factor: 5.731

# A Review Study on Various Applications of Pd(II) Metal Complexes Derived from Schiff bases

**Shikha Yadav[1], Suman Malik[1], Bharti Jain[2]**
Department of Chemistry, Sadhu Vaswani Autonomous College, Bhopal, M.P. India[1,2]
Department of Chemistry, Government M. L. B. Girls Autonomous College, Bhopal, M.P. India[3]
drsumanmalik@gmail.com, shikha.yadav63@gmail.com

**Abstract:** *In the development of co-ordination chemistry, Schiff base plays an important role with transition metals. They can easily form stable complexes. The high affinity of Schiff bases for the chelation helps them in the direction of preparing solid complexes. Metals like Co,Pd, V, Zn, Cr, Fe plays vital roles in the synthesis of Schiff base metal complexes. This review describe properties and applications of Pd(II) metal complexes derived from different Schiff bases. These have various applications as therapeutic agents as antibacterial, antifungal, antidiabetic, antitumor, anticancer, and anti-inflammatory. Pd(II) complexes showed higher selectivity against cancer cell line. These complexes also show catalytic properties in many chemical reactions. Present review is an attempt to compile various applications of Pd(II) metal complexes with Schiff bases..*

**Keywords:** Schiff Bases, Metal Complexes, Pd (II) Metal Ion, Biological Activity

## I. INTRODUCTION

Schiff bases have an important role in inorganic chemistry, because they can easily form stable complexes with most metal ions **(1-2)**. Schiff bases are formed when any primary or secondary amine react with an aldehyde or a ketone under specific conditions. Schiff base also called imine or azomethine**(3-4)**. Coordination chemistry, which is widely developed in the last few decades, is highly considered in inorganic, organic and biological fields **(5-8)**. Moreover it has always been a challenge to the chemists as it has more branches now-a-days **(9-14)**. The high affinity for the chelation of the Schiff base towards the transition metal ions is utilized in preparing their solid complexes **(15)**. Schiff bases can bind with different metal centers involving various coordination sites and allow successful synthesis of metal complexes **(16)**. The reaction of these donor ligands and metal ions gives complexes of different geometries and literature survey reveals that these complexes are biologically active compounds. Thus, because of their extensive biological activities, inrecent years, Schiff bases and their metal complexes have attained much attraction **(17-18)**.

## II. PALLADIUM

Palladium metal was discovered in 1803 by the British chemist William Hyde Wollaston. He named it after the acquired asteroid Pallas, and he himself named it after the Greek goddess Athena. Palladium, platinum, rhodium, ruthenium, iridium, and osmium form a group of elements called platinum group metal. Palladium, designated with the symbol Pd and atomic number 46, has the lowest melting point. More than half of palladium and related platinum reserves are used in catalytic converters, which convert up to 90% of the harmful gases in automobile exhaust (hydrocarbons, carbon monoxide and nitrogen dioxide) to less harmful substances (nitrogen, carbon dioxide) and water vapor).Palladium is also used in electronics, dentistry, medicine, hydrogen refining, the chemical industry, groundwater treatment and jewelry. Palladium is a key component in fuel cells where hydrogen reacts with oxygen to generate electricity, heat and water. It is soft and ductile when annealed, and increases in strength and hardness significantly when cold worked. Palladium dissolves slowly when finely ground in concentrated nitric acid, hot concentrated sulfuric acid, or hydrochloric acid. Palladium does not react with oxygen at standard temperature and therefore does not discolor in air. Palladium heated to 800°C forms a layer of palladium(II) oxide. Over time, it may gradually acquire a light brown color. This is probably due to the formation of a surface layer of carbon monoxide **(19-22)**.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 12, Issue 4, December 2021
Impact Factor: 5.731

## III. Biological Application Of Metal Complexes Of Palladium (II) Derived From Schiff Bases

Schiff base shows various type of application when Schiff ligand interacts with palladium metal salt of Palladium.

### 3.1 Antibacterial Activity

**B. Geeta, K. Shravankumar*et al.* (23)** reported new Schiff-base ligand with a phenylene spacer, afforded by the condensation of glycyl–glycine and *o*-phthalaldehyde has been served as an octadentate $N_4O_4$ ligand in designing some binuclear complexes of palladium(II). Metal complexes were examined by elemental and spectroscopic analysis. Metal complexes have shown to good antibacterial activity against *Gram-positive* and *Gram-negative bacteria*.

**Anaconaet *al.*(24)** reported that a complexes of Schiff base ligand, with Pd (II) ions was synthesized by the condensation of 1,10-phenanthroline-2, 9-dicarboxaldehyde, 2,3-diamino-1,4-naphthoquinone and 1,2-dibromoethane in ethanol. The complex is characterized by physicochemical and spectroscopic methods. They tested its antibacterial activity against several bacteria, and compared with the activity of penicillin.

**T. Vadivelet *al.* (25)** manychitosan complexes of Schiff base and palladium (II) were synthesized by the chemical reaction of chitosan with an aldehyde. Antibacterial screening of complexes and ligands against bacterial pathogens such as *P. aeruginosa*, *Staphylococcus aureus* and *Streptococcus pyogenes*.

**EmadYousifet *al.* (26)** reported that ametal complex derivatives of 2N salicylidene 5 (*p*-nitro phenyl) 1, 3, 4-thiadiazole with the metal ions Pd(II) was successfully obtained in an alcoholic medium. The resulting complexes were characterized quantitatively and qualitatively by using micro elemental analysis, FTIR spectroscopy, UV–Vis spectroscopy, mass spectroscopy, $^{1}H$ and $^{13}C$ NMR, magnetic susceptibility and conductivity measurements. Preliminary screening for in *vitro* antibacterial activity.

### 3.2 Antifungal Activity

**Oshin Sebastian *et al.* (27)** tested palladium (II) complexes with salicylideneimide and triphenylphosphine ligands using the Suzuki-Miyaura coupling reaction of various aryl bromides with aryl boronic acids. This complex is widely showed high catalytic activity, antibacterial and antifungal properties, antitumor and excellent biological properties.

**Westcott *et al.* (28)** reported the addition of Schiff's base from sulfonamides or aminobenzothiazoles to Pd Acetate. The reaction of Schiff bases containing pyrimidine groups resulted in several products arising from the competitive coordination of the pyrimidine nitrogen atoms. Palladium complexes and Schiff bases have been investigated as antifungal agents against *Aspergillusniger* and *Aspergillusflavus*.

**K. Yadav *et al.* (29)** reported the schiff ligand used in these studies are semi carbazones and thiosemicarbazones and prepared by the condensation of diketones with thiosemicarbazides and semi carbazide hydrochloride in ethanol. The activity of complexes against pathogens, indicating that complexes with metals enhance the activity of ligand.

### 3.3 Antimicrobial Activity

**Mehmet Gulcanet *al.* (30)** synthesized Schiff base, {1-[(5-bromo-2-hydroxy-benzylidene)- amino]-4-phenyl-2-thioxo-1,2-dihyro-pyrimidin-5-yl}-phenyl-methanone, was synthesized from N-amino pyrimidine-2-thione and 5-bromsalicylaldehyde. Metal complexes of the Schiff base were formed fromPd(II) in methanol. The compounds were evaluated for their antimicrobial against *gram-positive* bacteria, *gram-negative* bacteria, and yeast strains.

**C.E. Satheeshet *al.*(31)** synthesized Schiff base ligand by condensation of 2-(3,4-dimethoxyphenyl)ethanamine with 2-hydroxy benzaldehyde and 2′-hydroxy acetophenone respectively. The antimicrobial activity of new Schiff base ligands and their Pd(II) complexes against pathogenic microbial strains. The complexes also showed important antibacterial and antifungal activities.

**M. Tumer *et al.*(32)**using the new amine N-(pyridyl)-2-hydroxy-3-methoxy-5-aminobenzylamin 3-hydroxysalicylaldehyde, 4-hydroxysalicylaldehyde and 5-bromosalicylaldehyde Schiff base ligand prepared. Antimicrobial activities of the ligands and their complexes have been tested against to the *Bacillus subtilis, Micrococcusluteus,* andyeast.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 12, Issue 4, December 2021
Impact Factor: 5.731

### 3.4 Anticancer Activity

**N. Ahmad*et al.*(33)**synthesized tetradentate Schiff base 2,2'-((1*E*,1'*E*)-((2,2-dimethylpropane-1,3-diyl)bis-(azanylylidene)) bis(methanylylidene)) bis (4-fluorophenol) and its complex Pd (II). Compoundsare determined by UV-Visible, NMR, IR spectroscopy and single crystal x-ray diffraction. Therefore, with respect to human colorectal cancer cell lines.

**Elsayed*et al.* (34)**A Pd(II) complex with a Schiff base based from 3-formylchromone and benzohydrazide was synthesized. These compounds are characterized based on physicochemical and spectroscopic methods. The Pd(II) complex has been tested as anticancer agents against the human breast cancer and human ovarian cancer cell lines.

**H. Laila*et al.* (35)** synthesized Pd (II) and complexes of bidentate Schiff base ligand 2-[(4-chlorobenzylidene)amino] phenol. It showed good results for inhibiting the studied pathogenic microorganisms. The anticancer effect of HL and its complexes, on selected human cell lines was determined. The results of cytotoxicity showed that the prepared complexes are more effective ligand of the Schiff base.

### 3.5 Catalytic Activity

**K.C. Gupta et al. (36)** synthesized pyridylbis(imide) and pyridine bis(imine) complexes of ions palladium(II) have been used as catalysts in the polymerization of ethylene and propylene. The phenoxy-imine complexes of palladium(II) were also used as catalysts in the polymerization of ethylene. Schiff base complexes showed significant activity in catalyzing allylicalkylations, hydrosilation, the decomposition of hydrogen peroxide, isomerization, and annulation and carbonylation reactions.

**Mustafa Kemal Yilmaza *et al.* (37)**prepareda new series of ligand-bearing iminophosphinePd(II) complexes and characterized them using spectroscopy. The complex was tested as a catalyst for the Heck and Suzuki reaction. The coupling reaction actually performed using catalyst 2a-2c shows high conversion under certain conditions using para-substituted aryl halide.

## IV. Conclusion

Schiff bases and their prepared metal complexes are considered as a very important class of organic and inorganic compound because of their biological activities. Pd complexes of Schiff bases have shown a broad range of catalytic and biological activities, including antibacterial, antifungal, antitumor properties.

## References

**[1].** A.W. Kleij, Nonsymmetrical salen ligands and their complexes: Synthesis and applications, Eur. J. Inorg. Chem., 193- 205, 2009.

**[2].** P. Das, W. Linert, Schiff base-derived homogeneous and heterogeneous palladium catalysts for the Suzuki–Miyaura reaction, Coord. Chem. Rev., 311, 1-23, 2016.

**[3].** S. A. Talouki, G. Grivani, P. Crochet, V. Cadierno, Half-sandwich ruthenium (II) complexes with water-soluble Schiff base ligands: Synthesis and catalytic activity in transfer hydrogenation of carbonyl compounds, Inorg. Chim. Acta, 456, 142-148, 2017.

**[4].** A.A. Alshaheri, M. I. M. Tahir, M. B.A. Rahman, T. Begum, T. A. Saleh, Synthesis, characterisation and catalytic activity of dithiocarbazate Schiff base complexes in oxidation of cyclohexane, J. Mol. Liq., 240, 486-496, 2017.

**[5].** S. Chandra and S.D. Sharma, Chromium(III), manganese(II), cobalt(II), nickel(II), copper(II) and palladium(II) complexes of a 12-membered tetraaza [N4] macrocyclic ligand, Trans. Met. Chem., 27:732-739, 2002.

**[6].** S. Chandra andR. Kumar, Synthesis and spectroscopic characterization of transition metal complexes of a 12-membered tetraaza[N4] macrocyclic ligand and their biological activity,Trans. Met. Chem., 29, 2693-2704, 2004.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 12, Issue 4, December 2021
Impact Factor: 5.731

**[7].** M.R. Malachowski , B. T. Dorsey, M.J. Parker, M. E. Adams and R.S. Kelly, Synthesis, characterization, and X-ray crystal structure of cobalt(III) complexes with a N2O2-donor Schiff base and ancillary ligands: Spectral, antibacterial activity, and electrochemical studies, Polyhedron, 17, 1289-1296, 1998.

**[8].** S. Arulmurugan, H.P. Kavitha and B.R. Venkatraman, Biological activities of Schiff base and itscomplexes: a review, Rasayan J. Chem., 3(3):385-410, 2010.

**[9].** D. Kumar,S. Chadda , J. Sharma and P. Surain, Syntheses, Spectral characterization, and antimicrobial studies on the coordination compounds of metal ions with schiff base containing both aliphatic and aromatic hydrazide moieties,Bioinorg. Chem. Appl., 10.1155, 2013.

**[10].** M.J. Maclachlan, M.K. Park and L.K. Thompson, Coordination compounds of schiff-base ligands derived from diaminomaleonitrile (DMN): mononuclear, dinuclear, and macrocyclic derivatives, Inorg. Chem., 35(19), 5492-5499, 1996.

**[11].** S. Malik , S. Ghosh and L. Mitu, Complexes of some 3d-metals with a schiff base derived From 5-acetamido-1,3,4-thiadiazole-2-sulphonamide and their biological activity,J. Serb. Chem. Soc.,76(10), 1387-1394, 2011.

**[12].** M.A. Phaniband and S.D.Dhumwad, Synthesis, characterization and biological studies of Co(II), Ni(II), Cu(II) and Zn(II) complexes of schiff bases derived from 4-substituted carbostyrils[quinolin2(1H)-ones, Trans. Met. Chem.,32(8): 1117-1125, 2007.

**[13].** S. Chandra , D. Jain , A.K. Sharma and P. Sharma, Coordination modes of a schiff base pentadentate derivative of 4-aminoantipyrine with cobalt(II), nickel(II) and copper(II) metalions: synthesis, spectroscopic and antimicrobial studies, Molecules. 14(1): 174-190, 2009.

**[14].** H. Naeimi, J.Safari and A. Heidarnezhad, Synthesis of schiff base ligands derived from Condensation of salicylaldehyde derivatives and synthetic diamine, Dyes and Pigment.,73(2):251-253, 2007.

**[15].** Alexander V. Design and synthesis of macrocyclic ligands and their complexes of lanthanides and actinides,Chem Rev, 95, 273-342, 1995.

**[16].** A.G. Quiruga, C.N. Ranninger, Review contribution to the SAR field of metallated and coordination complexes: studies of the palladium and platinum derivatives with selected thiosemicarbazones as antitumoral drugs, Coord Chem Rev.,248, 119-33, 2004.

**[17].** X.W. Douglas, E. Anthony, Thiosemicarbazone complexes of copper(II): structural and biological studies, CoordChem Rev, 123, 49-71, 1993.

**[18].** W. Tuo, G. Zijian, Copper in medicine: homeostasis, chelation therapy and antitumor drug design, Curr Med Chem, 13, 525-37, 2006.

**[19].** Meija, Juris, Atomic weights of the elements 2013 (IUPAC Technical Report) ,Pure and Applied Chemistry, (3), 265–91, 2016.

**[20].** D. R. Lide, Magnetic susceptibility of the elements and inorganic compounds, CRC Handbook of Chemistry and Physics (PDF) (86th ed.), 20-8493, 0486, 5, 2005.

**[21].** Weast, Robert, CRC, Handbook of Chemistry and Physics. Boca Raton, Florida: Chemical Rubber Company Publishing. E110, 0-8493-0464-4, 1984.

**[22].** Jump,Hammond, C. R.,The Elements, Handbook of Chemistry and Physics (81st ed.), 0485-9, 2004.

**[23].** B. Geeta, K. Shravankumar, Binuclear cobalt(II), nickel(II), copper(II) and palladium(II) complexes of a new Schiff-base as ligand: Synthesis, structural characterization, and antibacterial activity, Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy, 77, 4, 911-915, 2010.

**[24].** J. R. Anacona, E. Bastardo and Camus. Manganese (II)And palladium(II) complexes containing a new macrocyclic Schiff base ligand: antibacterial properties, Transition Metal Chemistry, 24, 478-480, 1999.

**[25].** T. Vadivel, M. Dhamodaran and K. Singaram,Antibacterial Activities of Palladium (II) Complexes Derived from Chitosan Biopolymer Schiff Base, Journal of Bacteriology and Mycology, 2015.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 12, Issue 4, December 2021
Impact Factor: 5.731

**[26].** EmadYousif, Ahmed Majeed, Khulood Al-Sammarrae, Nadia Salih, JumatSalimon, Bashar Abdullah, Metal complexes of Schiff base: Preparation, characterization and antibacterial activity, Arabian Journal of Chemistry, 10, 2, 163, 2017.

**[27].** Oshin Sebastian and AshwinThapa,Schiff base metal complexes of Ni, Pd and Cu, Journal of Chemical and Pharmaceutical Research, 7(10), 953-963, 2015.

**[28].** Westcott, Palladium(II) Schiff base complexes derived from sulfanilamides and aminobenzothiazoles, Transition Metal Chemistry,30:411–418, 2005.

**[29].** K. Yadav, S. Varshney and A.K. Varshney, Synthesis, Spectral and Antimicrobial Investigation of Some New Coordination compounds of Palladium (II) with Biologically Active Nitrogen donor Ligands, J.Appli.Chem., 1097- 1104, 72-78, 2016.

**[30].** Mehmet Gulcan, Mehmet Sonmez, Ismet Berber, Synthesis, characterization, and antimicrobial activity of a new pyrimidine Schiff base and its Cu(II), Ni(II), Co(II), Pt(II), and Pd(II) complexes,Turk. J. Chem. 36, 189 – 200, 2012.

**[31].** C.E. Satheesh, P. Raghavendra Kumar, P. Sharma, K. Lingaraju, B.S. Palakshamurthy, H. Raja Naika, Synthesis, characterisation and antimicrobial activity of new palladium and nickel complexes containing Schiff bases, InorganicaChimicaActa, 442,1-9, 2016.

**[32].** M. Tumer,, H. Koksal., M.K. Sener, Antimicrobial activity studies of the binuclear metal complexes derived from tridentate Schiff base ligands, Transition Metal Chemistry ,24, 414–420, 1999.

**[33].** N. Ahmad, E.H. Anouar, A.M. Tajuddin, K. Ramasamy, Synthesis, characterization, quantum chemical calculations and anticancer activity of a Schiff base NNOO chelate ligand and Pd(II) complex, journal.pone.,10.1371, 2020.

**[34].** Elsayed, S.A., Butler, I.S., Claude, B.J. et al. Synthesis, characterization and anticancer activity of 3-formylchromone benzoylhydrazone metal complexes, Transition Met Chem, 40, 179–187, 2015.

**[35].** Laila H. Abdel-Rahman, Mohamed Shaker S. Adam, Synthesis, theoretical investigations, biocidal screening, DNA binding, in vitro cytotoxicity and molecular docking of novel Cu (II), Pd (II) and Ag (I) complexes of chlorobenzylidene Schiff base: Promising antibiotic and anticancer agents, applied organometallic chemistry, 10,1002, 4527, 2018.

**[36].** K.C. Gupta, Alekha Kumar Sutar, Catalytic activities of Schiff base transition metal complexes, Coordination Chemistry Reviews, 252, 12–14, 1420-1450, 2008.

**[37].** Mustafa Kemal Yılmaza , Mustafa Keleşb, The catalytic activity of Palladium(II) complexes containing PN ligands in the Heck and Suzuki C-C coupling reactions, JOTCSA. 25(1), 133, 2018.