Professor R.N.Goyal

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Personal

Date of Birth; June 01, 1951 Sex: Male
Nationality: Indian
Married

Academic Qualifications

M.Sc. – Agra University 1972
Ph.D. – Roorkee University 1975
D.Sc. – Agra University 1991

Research Area: Sensors and biosensors for biomolecules, drugs and doping agents. Molecular Electrochemistry-analytical and mechanistic aspects and electrochemistry at nanomaterial modified electrodes.

Academic Experience

Jan.2005-- Present	Professor,Chemistry Department, IIT Roorkee
April 2002 – Dec. 2004	Professor and Head, Chemistry Department, IIT Roorkee
April 1996 - March 2002	Professor, Chemistry Department, IIT Roorkee,
Jan. 1986 - March 1996	Reader, Chemistry Department, University of Roorkee, Roorkee
Aug. 1975 - Jan. 1986	Lecturer, Chemistry Department, University of Roorkee, Roorkee

Academic Distinctions

(i) Visiting Scientist of British Council Young Exchange Program from February 1979 to June1979 at University of Loughborough,UK.

(ii) Research Associate at Chemistry Department, University of Oklahoma, USA from June 1979 to June 1982 and again from June1989 to June1991.

(iii) Visiting JSPS [Japan Society for the promotion of Science] fellow from Dec 2003 to Jan 2004, December 2008 to Jan 2009 and December 2014 to Jan. 2015 at Kyoto University, Japan

(iii) Khosla Research Awards in the years

1992 - Silver medal and a cash prize of Rs. 1000/-
1994 - First Khosla research prize
1995- Gold medal and cash prize of Rs.2500/-

(iv) Electrochemical Society, Indian Academy of Sciences, Bangalore, certificate of merit award in1993 for the research paper on “Oxidation of xanthosine”.

(v) Member of the Editorial Board of Indian J. Chemistry A , published by C.S.I.R., NewDelhi since1999.

(vi) Secretary, Society of Bioelectroanalytical Chemistry of India, Tata Institute of Fundamental Research, Mumbai since 1994 to 2001.

(vii) Coordinator, Departmental Research Support (DRS) Programme of UGC, New Delhi from 1994 to 2003.

(viii) Coordinator, COSIST Programme of UGC in the department 2001-2006.

(ix) Organized three National symposiums on, ”Recent Trends in Instrumental Methods of Analysis” in1991,1994 and1997.

(x) Organized 21st conference of Indian Council of Chemists at IIT Roorkee during October 17th to19th 2003.

(xi) Chairman, Electroorganic and inorganic group of Society for Advancement of electrochemical science and Technology (SAEST), Karaikudi.

(xii) Member of the editorial board of International Journal of Electrochemical Science.

(xiii) **Dean, Postgraduate Studies and Research**,IIT Roorkee from Jan.01, 2005 to Dec.31, 2006.

(xiv) Visiting Professor, Kyoto University from Jan 01, 2007 to March 31st 2007.

(xv) Associate Editor, Advanced Science Letters, published by AmericanScientific Publishers, USA.

(XVI) Visiting Professor, Pusan National University, South Korea from Dec. 10, 2011 to Dec.09, 2012

Administrative / Other Responsibilities

(i) Served on the Panel of Head of the Chemistry Department for two terms of three years each.

(ii) Deputy Chief Sports Adviser, Institute Sports Association, IIT Roorkee [May 2000 to May 2003].

(iii) Chairman, Academic Program Committee of the department

(iv) Associate Dean, Academic Programmes, IIT Roorkee - January 01, 2001 to March31st 2002.

(v) Head, Department of Chemistry, IIT Roorkee – April 01, 2002 to Dec.31, 2004

(vi) **Dean, Postgraduate Studies and Research**, IIT Roorkee from Jan. 01, 2005 to Dec 31, 2006.

Membership

(i) Fellow, Indian Chemical Society, Calcutta
(ii) Fellow, Society for Advancement of Chemical Science and Technology, Karaikudi
(iii) Secretary, Bioelectrochemical society of India
(iv) Life Member,Indian Science Congress
(v) Life Member, Indian Society for electroanalytical chemistry, BARC. Mumbai

Publications/ Ph.D / Projects/Patents

Research papers - >310
Ph.D- 42
M.Sc./M.Phil- 35
Patent – 1 [Ind. C.I. 55E; Int. C.I. A61K 31/705]

More than 310 research papers have been published in the journals of International repute. Present 'h' value is 33. Forty two students have been awarded Ph.D. under my supervision and twenty students have worked for their M./Sc, M.Phil dissertation under my supervision. A recent list of publications is attached as Annexure1.

Several research projects sponsored by DST, CSIR, UGC, ICMR, AICTE have been successfully completed.

Presented technical papers and Invited lectures in numerous National and International conferences, seminar and workshops. Patent – 01; Book – 01. entitled, " Text book of Applied Chemistry" published by Ane Books, Delhi for Engineering students.

- **Guest Editor** of a special issue [April 2003] of Indian J.Chemistry-Dynamic Electrochemistry on the diamond jubilee of CSIR, New Delhi.

- **Guest Editor** of a special issue of Indian J. Chemistry-A [May 2005] – Nanomaterials and electrochemistry, published by CSIR, New Delhi.

Significant Contributions:

During the last three decades I have worked on the electrochemical reduction of biologically important compounds. A variety of biomolecules viz., purine derivatives and indoles have been studied. A comparison of electrochemical oxidation with horseradish peroxidase catalyzed oxidation of uric acids and guanine indicated that both the oxidations proceed by identical mechanism. The products of oxidation were characterized. A correlation between oxidation potentials and frontier molecular orbital energies has also been established. The studies on the oxidation of guanosine and 8-hydroxy guanosine were found to give an oxygen linked dimer as the major product and its toxicity was evaluated by monitoring changes in blood parameters in albino mice. It was found that intracranial injection of single dose of the oxygen linked dimer in mice caused nephritis with edema and hence was found toxic in nature. This contribution is described in book on, Electrochemistry of biologically significant molecules, published by AcademicPress,1991 and is also widely quoted by others as evidenced in Citation Index, h = 33.

R.N. Goyal, N**.** Jain, D.K. Garg, Electrochemical and enzymic oxidation of guanosine and 8-hydroxyguanosine and the effects of oxidation products in mice. *Bioelectrochemistry and Bioenergetics* (1997),43(1),105-114.

Times cited upto 2013 - 64

Another contribution made is in the area of oxidation chemistry of central nervous system Indoles, where oxidation of Indole, 4-hydroxyindole, 5- hydroxyindole, 5-hydroxytryptamine etc.have been studied and a variety of dimers, trimers and oligomers have been isolated and characterized as the products of oxidation. The toxicity of these oligomers has also been evaluated in albino mice and compared with basic compounds. It is expected that these studies will provide basis for the abnormal oxidation of these compounds which is responsible for Alzheimer's and Parkinson's diseases.

R.N. Goyal, N.Kumar, N.K.Singhal, Oxidation chemistry and biochemistry of indole and effect of its oxidation product in albino mice. *Bioelectrochemistry and Bioenergetics* (1998), 45(1), 47-53.

Times Cited upto 2013- 24

During last decade, we have started determination of bio-molecules at nanogold modified electrodes, carbon naotubes or C_{60} modified electrodes in human blood plasma and urine. A variety of purines and their nucleosides and commonly used drugs viz., paracetamol, atenolol, salbutamol etc. have been determined. The determination of paracetamol using voltammetric method was reported for the first time by us. The cross validation of data with GC-MS indicated that the developed methods are sensitive, selective, rapid and can be easily used for determining these compounds. Anabolic steroids widely used by athletes in competitive games have also been determined in blood plasma and urine using voltammetric methods at carbon nanotube or nanogold modified electrodes.

Some top cited papers

R.N. Goyal, V.K. Gupta, M. Oyama, N. Bachheti, Differential pulse voltammeteric determination of paracetamol at nanogold modified indium tin oxide electrode, *Electrochem.Commun*., 7 (2005) 803-807.

Times cited upto 2014 – 182

R.N. Goyal, V.K. Gupta, N. Bachheti, Fullerene-C 60-modified electrode as a sensitive voltammetric sensor for detection of nandrolone—an anabolic steroid used in doping, Anal Chim Acta., 597 (2007) 82-89.

Times cited upto 2014 – 176

R.N. Goyal, S.P.Singh, Voltammetric oxidation of paracetamol at C60 modified glassy carbon electrode, *Electrochimica Acta*, 51 (2006) 3008-3013.

Times cited upto 2013 - 112

R.N. Goyal, M. Oyama, V.K.Gupta, S.P.Singh, R.A.Sharma, Sensors for 5-hydroxytryptamine and 5-hydroxyindole acetic acid based on nanomaterial modified electrodes, *Sensors Actuators B*, 134 (2008) 816-821.

Times cited upto 2013 - 115

ANNEXURE 1

RECENT PUBLICATIONS

1. P. Gupta, **R.N. Goyal**, Sensitive determination of domperidone in biological fluids using a conductive polymer modified glassy carbon electrode, *Electrochimica Acta*, 151, 2015, 1-7

2. Neeta Thapliyal, R. V. Karpoormath, **R. N. Goyal**, Electroanalysis of antituberculardrugs in pharmaceutical dosage forms and biological fluids: A review, *Analytica Chimica Acta*, 853, 2015, 59-76.

3. P. Gupta, S.K.Yadav, **R.N.Goyal**, A sensitive polymelamine modified sensor for thedetermination of lomefloxacin in biological fluids, *J. Electrochem. Soc.*, 162, 2015, H 86-92

4. Rosy, **R.N.Goyal**, Estimation of amoxicillin in presence of high concentration ofuric acid and other urinary metabolites using an unmodified pyrolytic graphite sensor, *J. Electrochem. Soc*., 162, 2015, G 8-13

5. Saurabh K. Yadav, Pravir K. Choubey, Bharati Agrawal, **R. N. Goyal**, Carbon nanotube embedded poly 1,5-diaminonapthalene modified pyrolytic graphite sensor for the determination of sulfacetamide in pharmaceutical formulations, *Talanta*, 118, 2014, 96-103.

6. Dong-Min Kim, Mi-Sook Won, Jang-Hee Yoon, Jung Ho Kim, **R. N. Goyal** and Y.-B Shim, Chiral Recognition of Proline Enantiomers by the Catalytic Oxygen Reduction and Formation of Cu(II)-Polymer Complex Crystals, *Electroanalysis*, 26, 2014, 2110-17.

7. P Gupta, **R. N. Goyal**, Polymelamine modified edge plane pyrolytic graphite sensor for the electrochemical assay of serotonin, *Talanta*, 120, 2014, 17-22.

8. Saurabh K. Yadav, Rosy, M. Oyama, **R. N. Goyal**, A biocompatible nanogold modified palladium sensor for determination of dopamine in biological fluids, *J. Electrochem. Soc*.,161, 2014, H41-H46.

9. S.Bishnoi, **R. N. Goyal**, Yoon-Bo Shim, A novel nanogold -single wall carbon nanotube modified sensor for the electrochemical determination of 8-hydroxyguanine, a diabetes risk biomarker, *Bioelectrochemistry*, 99, 2014, 24-29.

10. P. Gupta, S.K. Yadav, B. Agrawal, **R.N. Goyal**, A novel graphene and conductive polymer modified pyrolytic graphite sensor for determination of propranolol in biological fluids *Sensors and Actuators,* B: Chemical, 204, 2014, 791-798.

11. Rosy, H. Chasta, **R.N. Goyal**, Molecularly imprinted sensor based on o-aminophenol for the selective determination of norepinephrine in pharmaceutical and biological samples, Talanta, 125, 2014, 167-173

12. S.K.Yadav, B. Agrawal, P. Chandra, **R.N. Goyal**, In vitro chloramphenicol detectionin a Haemophilus influenza model using an aptamer-polymer based electrochemical biosensor, *Biosensors and Bioelectronics*, 55, 2014, 337-342

13. B. Agrawal, P. Chandra, **Rajendra N. Goyal**, Yoon- Bo Shim, Detection of norfloxacin and monitoring its effect on caffeine catabolism in urine samples, *Biosensors and Bioelectronics*, 47, 2013, 307-312.

14. **Rajendra N. Goyal**, Davinder Kaur, B. Agrawal, Saurabh Kumar Yadav, Electrochemical investigations of mometasone furoate, a topical corticosteroid, in micellar medium, *J. Electroanal. Chem*., 695, 2013, 17-23.

15. Saurabh K. Yadav, Bharati Agrawal, **Rajendra N. Goyal**, AuNPs-poly-DAN modified pyrolytic graphite sensor for the determination of Cefpodoxime Proxetil in biological fluids, *Talanta*, 108, 2013, 30-37.

16. Saurabh K. Yadav, P. Chandra, **Rajendra N. Goyal**, Yoon-Bo Shim, A review on determination of steroids in biological samples exploiting nanobio-electroanalytical methods, *Analytica Chimica Acta*, 762, 2013, 14-24.

17. P. Chandra, Nguyen X. Son, Hui-Bog Noh, **Rajendra N. Goyal**, Yoon-Bo Shim, Investigation on the down regulation of dopamine by acetaminophen administration based on their simultaneous determination in urine, *Biosensors and Bioelectronics*, 39, 2013, 139-144.

18. **Rajendra N. Goyal**, Anoop Raj Singh Rana, Himanshu Chasta, Simultaneous monitoring of aspirin, paracetamol and caffeine in human urine at poly-1,5-diaminonapthalene modified pyrolytic graphite sensor, *J. Electrochem. Soc.* 160(7): 2013, G3014-G3019.

19. Saurabh K. Yadav, P. Chandra, **Rajendra N. Goyal**, Yoon-Bo Shim, Chromatography - based determination of anabolic steroids in biological fluids: Future prospects using electrochemistry and miniaturized microchip device, *Chromatographia*, 76, 2013, 1439-1448.

20. Deog-Su Park, Mi-Sook Won, **Rajendra N. Goyal**, Yoon-Bo Shim, The electrochemical sensor for methanol detection using silicon epoxy coated platinum nanoparticles, *Sensors and Actuators B*: Chemical, 174, 2012, 45-50.

21. **Rajendra N. Goyal**, Bharati Agrawal, Ag ion irradiated based sensor for the electrochemical determination of epinephrine and 5-hydroxytryptamine in human biological fluids, *Analytica Chimica Acta*, 743, 2012, 33-40.

22. **Rajendra N. Goyal**, Anoop Raj Singh Rana, Himanshu Chasta, Electrochemical sensor for the sensitive determination of norfloxacin in human urine and pharmaceuticals, *Bioelectrochemistry*, 83, 2012, 46-51.

23. **Rajendra N. Goyal**, Anoop Raj Singh Rana, Himanshu Chasta, Electrochemical and peroxidase-catalyzed oxidation of epinephrine, *Electrochimica Acta*, 59, 2012, 492-498

24. **Rajendra N.Goyal**, S. Bisnoi, A novel multi-walled carbon nanotube modified sensor for the selective determination of epinephrine in smokers, *Electrochim Acta*, 56, 2011, 2717.