

Ioannis D. Kostas

PhD / Research Director

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Curriculum Vitae – Current Research Interests

Education

- 1991: PhD in Chemistry, National and Kapodistrian **University of Athens**, Greece
PhD Thesis (with Dr. C.G. Screttas, National Hellenic Research Foundation):
“Metal alkoxide modified organolithium reagents. Synthesis and stabilization of
substituted lithioxyalkylolithiums including the aza-analogues, in tetrahydrofuran,
in the presence of magnesium 2-ethoxyethoxide” (in Greek)
- 1986: Degree in Chemistry, Aristotle **University of Thessaloniki**, Greece
Prize for the excellent University students, State Scholarships Foundation
Undergraduate Thesis in Chemistry: “1,3-Dipolar cycloaddition of nitrile oxides
to 2,6-dibenzylidenecyclohexanone” (in Greek)

Appointments

- 1996-present: Researcher (Research Director since 2007), **National Hellenic Research Foundation**, Institute of Organic and Pharmaceutical Chemistry (renamed to Institute of Biology, Medicinal Chemistry and Biotechnology in 2012 as a result of the merger with the Institute of Biological Research and Biotechnology of the NHRF, and on 2019 renamed to Institute of Chemical Biology), Athens, Greece
- 2015-present: Visiting Professor, **University of Thessaly**, Department of Biochemistry and Biotechnology, Larissa, Greece
- 5-8/2007: Visiting Researcher, **Max-Planck-Institut für Kohlenforschung** (Reetz’s group), Mülheim an der Ruhr, Germany
- 1995-1996: Post-doctoral Fellow with Prof. Dr. M.T. Reetz/Director, **Max-Planck-Institut für Kohlenforschung**, Mülheim an der Ruhr, Germany
- 1994-1995: Post-doctoral Fellow with Prof. Dr. F. Bickelhaupt/Director (passed away on 30/12/2013), **Vrije Universiteit** (Free University), Amsterdam, The Netherlands

Current Research Interests

- *Transition metal homogeneous catalysis in organic synthesis*
Development of novel phosphane- and phosphane-free ligands, complexation with transition metals (e.g. Ru, Rh, Pd, Pt), investigation of the coordination mode in the complexes and their evaluation as homogeneous catalysts in organic reactions (e.g. hydroformylation, hydrogenation, Heck and Suzuki couplings), at room temperature, under conventional heating or microwave irradiation. Asymmetric catalysis and catalysis in aqueous media are included.
- *Catalysis by metal nanoparticles*
Development of new metal nanoparticles stabilized with organic molecules and applications as recyclable catalysts in the Suzuki reaction and the hydrogenation of unsaturated aldehydes.
- *Biologically active compounds – Medicinal chemistry*
Synthesis of bioactive organic and organometallic compounds and investigation of their bioactivity as potent drugs against certain diseases (e.g. diabetes type-2, cancer).

More details are given in a following section.

Commercial products

- One of our published metal complexes (*salicylaldehyde thiosemicarbazone palladium(II) chloride*; CAS No.: 219954-63-9) as an efficient catalyst for the Heck and Suzuki reaction in air was commercialized from over 20 companies including MERCK (SIGMA-ALDRICH) and it is commercially available (CAS No.: 219954-63-9).

Reference: Kostas, I.D. et al. Tetrahedron Lett. 46 (2005) 1967.

MERCK (SIGMA-ALDRICH) (Product No.: 674125); SANTA CRUZ (Product No.: sc-253529); American Custom Chemicals Corporation (Product No.: CHM0157495); Catalyz Pharma Co., Ltd. (Product No.: 8790); ENERGY CHEMICAL (Product No.: 674125); Shanghai Hanhong Chemical Co., Ltd. (Product No.: RA10460092); Chengdu Ai Keda Chemical Technology Co., Ltd. (Product No.: 104729); ABI (Product No.: AC2A01FOP); ChemDBPortal (Product No.: CDBP225501); ALPHA CHEMISTRY; Haihang Industry Co., Ltd.; Jinan Haohua Industry Co., Ltd.; Angene International Ltd.; Jinan Great Chemical Industry Co., Ltd.; Huiju Chem Co., Ltd.; Tractus Company Ltd.; and more ...

Highlights of our research activities

- ❖ First use of **metalloporphyrins** as catalysts in the Suzuki reaction and the hydrogenation of trans-cinnamaldehyde – recyclable catalysts in aqueous media (Tetrahedron Lett. 2007, 48, 6688; Eur. J. Inorg. Chem. 2011, 4709).

- ❖ **Me-ANILAPHOS**: a highly versatile chiral ligand for the Rh-catalyzed asymmetric olefin hydrogenation (Tetrahedron Lett. 2006, 47, 7947). Selected comments: (i) "excellent catalyst" (a critical review: L. Eberhardt, D. Armspach, J. Harrowfield, D. Matt Chem. Soc. Rev. 37 (2008) 839); (b) "highly versatile ligand class" (ALDRICH: D. Amoroso et al. Aldrichimica Acta 41 (2008) 20). The publication "Kostas, I.D., et. al. Tetrahedron Lett., 2006, 47, 7947" for Me-AnilaPhos in asymmetric hydrogenation is cited in a patent: Publication number DE102007059298 A1, Inventors Matthias Eggenstein, Francio Giancarlo, Walter Leitner, Applicant Rheinisch-Westfälisch-Technische Hochschule Aachen.
- ❖ Pioneers in the use of **thiosemicarbazones** as ligands in the Pd-catalyzed coupling reactions in air (Tetrahedron Lett. 2004, 45, 2923; Tetrahedron Lett. 2005, 46, 1967; Tetrahedron Lett. 2006, 47, 4403). It has been included in HIGHLIGHTS for the field "Transition Metals in Organic Synthesis": B.C.G. Söderberg Coord. Chem. Rev. 2006, 250, 2411. One of our Pd complexes is currently commercially available from over 20 companies including MERCK (SIGMA-ALDRICH).
- ❖ First use of a **hemilabile amino- and sulfur-containing phosphinite** as efficient ligand in the Pd-catalyzed Heck reaction (Tetrahedron 2003, 59, 3467). It has been included in HIGHLIGHTS for the field "Transition Metals in Organic Synthesis": B.C.G. Söderberg Coord. Chem. Rev. 2006, 250, 300. The publication "Kostas, I.D., et. al. Tetrahedron 2003, 59, 3467" is cited in a patent: Publication number WO2013135552 A3, Inventors Matthias Beller, Helfried Neumann, Xiao-Feng Wu, Renat Kadyrov, Applicant Evonik Industries Ag.
- ❖ First use of **non cyclic-amino bisphosphinites** as efficient ligands in the Rh-catalyzed hydroformylation (J. Organomet. Chem. 2001, 626, 221).

Honours, awards, distinctions, fellowships

- Publons Award 2016 as one of the top per cent of researchers contributing to the peer review of the field of chemistry.
- One of our metal complexes as an efficient catalyst for the Heck and Suzuki reaction in air is/was **commercially available** (CAS No.: 219954-63-9) by at least 20 companies, including SIGMA-ALDRICH (Product No.: 674125) with the following reference in the catalogues of several of the companies: Kostas, I.D. et al. Tetrahedron Lett. 46 (2005) 1967.
- Editorial Advisory Board: "Catalysts" (2020-present), "Journal of Chemistry" (2012-present), "Conference Papers in Chemistry" (2012-2015), "Dataset Papers in Chemistry" (2012-2017, closing), "ISRN Organic Chemistry", 2010-2017 (renamed to "International Scholarly Research Notices" in 2014; closing in 2017), "The Open Natural Products Journal" (2009-2015), "Journal of Medicinal Chemistry & Toxicology" (2016-present).

- 2009-2013: Member of the Management Committee in the COST action CM0802: European Phosphorus Sciences Network (PhoSciNet).
- 2008: "Leonidas Zervas" Prize in Organic Chemistry (5/3/2008): K.A. Vallianatou for her PhD Thesis in "Asymmetric Catalysis" supervised by I.D. Kostas.
- 2008: Comments by third parties for the highly efficient chiral ligand known as Me-AnilaPhos developed by Kostas for the asymmetric hydrogenation: (i) "excellent catalyst" (a critical review: L. Eberhardt, D. Armspach, J. Harrowfield, D. Matt Chem. Soc. Rev. 37 (2008) 839); (b) "highly versatile ligand class" (ALDRICH: D. Amoroso et al. Aldrichimica Acta 41 (2008) 20).
- Recognition as pioneer on the use of (i) non cyclic-amino bisphosphinites as efficient ligands in the Rh-catalyzed hydroformylation; (ii) thiosemicarbazones as ligands in the Pd-catalyzed coupling reactions, and (iii) metalloporphyrins as catalysts in the Suzuki reaction and the hydrogenation of unsaturated aldehydes, as indicated by papers reported by third parties.
- Named references to Kostas' work in a number of papers reported by others, such as "Kostas and co-workers first reported ...".
- Keynote speaker in scientific meetings and invited speaker in Universities and Research Institutes.
- Invited author for original articles, reviews and book chapters as well as Editor of special issues and books.
- Invited reviewer for proposals and fellowships within National, European and American programmes, e.g. State Scholarships Foundation, General Secretariat of Research and Technology, COFUND (FP7), HORIZON-MSCA-DN, ACTS-ASPECT (Dutch Research Council NOW), Portuguese Foundation for Science and Technology (FCT), American Chemical Society Petroleum Research Fund.
- Invited reviewer for a number of papers (as well as Editor in Chief or Special Issue Guest Editor) by 49 scientific journals.
- Parts of our work have been included in HIGHLIGHTS for the field "Transition Metals in Organic Synthesis".
- 1999: Fellowship from TMR programme (E.U.) for participation on the "2nd Summer School on Green Chemistry", Venice (Italy), September 6-12, 1999.
- 1994-1996: Post-doctoral Fellowships, Human Capital and Mobility Programme.
- 1987-1991: Post-graduate Fellowship, National Hellenic Research Foundation.
- 1985: Prize for the excellent University students, State Scholarships Foundation.

Teaching and Supervision Experience

- Coordinator of the training seminar "Contemporary Organic Chemistry and Applications" for high school teachers, Athens, May 1998.

- Courses in "Transition-metal homogeneous catalysis. Applications to organic synthesis" within the EST Marie Curie "EURODESY" (2006-2010).
- Courses at the MSc programme "Bio-entrepreneurship" (2015 – present). Topic of the courses: "Dendrimers and Bioapplications".
- Courses at the MSc programme "Oncology "From Oncogenesis to Therapy" (2018 – present). Topic of the courses: "Drug Nanocarriers, Part A: Dendrimers".
- Supervisor of undergraduate, MSc, PhD students and Post-docs.
- Keynote speaker in: (a) the educational event SCIENCE in SOCIETY, Athens, 12 December 2011; (b) Workshop "Chemistry and Research Challenges" for undergraduate and graduate students, Athens 23-24/4/2013; (c) educational event for the general public "Green Chemistry", Athens, 11 & 18 March 2014; (d) educational workshops, e.g. "Targeted Drug Discovery Workshop", Athens, 10-14 October 2016.
- Keynote speaker and head in educational chemistry experiments under specific cultural events for school children and for the general public, e.g. (a) "Chemistry, our life, our future", NHRF – 27/2/2011; (b) "Sunday Mornings", NHRF – 20/11/2011; (c) "Science and Technology Festival 2012", NHRF, 13-16/12/2012; (d) 1st Athens Science Festival (30/4-4/5/2014), Technopolis Municipality of Athens, (e) "Green Chemistry, a Growing Environmental Need", interview in Tech Talks Central, 27/6/2015, (f) 3rd Athens Science Festival (5-10/4/2016), Technopolis Municipality of Athens, People's University (22/10/2018), etc.
- "Researcher's Night": NHRF–28/9/2012; Demokritos–27/9/2013, NHRF–12/9/2014 (Athens).

Membership of Scientific Societies

(i) Association of Greek Chemists; (ii) Association of Greek Researchers; (iii) American Chemical Society (1998-2014); (iv) Editorial Advisory Board "Catalysts" (2020-present), "The Open Natural Products Journal" (2009-2015), "ISRN Organic Chemistry" (renamed to "International Scholarly Research Notices") (2010-present), "Dataset Papers in Chemistry" (2012-2017; closing), "Journal of Chemistry" (2012-present), "Conference Papers in Chemistry" (2012-2015); "Journal of Medicinal Chemistry & Toxicology" (2016-present), (v) Member of the Management Committee (2009-2013) of the COST action CM0802: European Phosphorus Sciences Network (PhoSciNet).

Lectures/Oral Presentations in Universities, Research Institutes, Conferences and for the general public (including those as invited speaker)

Nea Genia Ziridis, Cambridge International School, Athens 18 February **2020**; People's University, Athens 23 October **2018**; Centre for Research and Technology-Hellas (CERTH), Thessaloniki 6 December **2017**; 22nd Hellenic Chemistry Conference,

Thessaloniki 2-4 December **2016**; Athens International Catalysis Symposium 2016 (AICS 2016), 3–4 November **2016**; Targeted Drug Discovery Workshop (Dendrimers: synthesis, properties & biomedical applications), National Hellenic Research Foundation, 12 October **2016**; 3rd Athens Science Festival (The magic of chemistry and its contribution to a sustainable development), 6th April **2016**; 12th Greece-Cyprus Conference, Thessaloniki 8–10 May **2015**; National Hellenic Research Foundation (The Contribution of Chemistry to a Sustainable Development - lecture to the general public), Athens 27th January **2015**; 4th Hellenic Symposium "Green Chemistry and Sustainable Development", Ioannina, 30 October – 1 November **2014**; 20th International Conference on Phosphorus Chemistry (ICPC 2014), Dublin, Ireland, 28th June – 2nd July **2014**; 1st Athens Science Festival (Green Chemistry), 4th May **2014**; National Hellenic Research Foundation (Green Chemistry – lecture to the general public), Athens 18th March **2014**; National Hellenic Research Foundation, Athens 27th November **2013**; 6th Swedish-Hellenic Life Science Research Conference, Athens, 14-15 November **2013**; Workshop "Chemistry and Research Challenges", Athens, 23-24 April **2013**; 5th NHRF - Örebro University Life Science Research Conference, Athens, 11-12 October **2012**; Educational Event – SCIENCE in SOCIETY "The Role of Chemistry in the design and synthesis of potential drugs", Athens, 12 December **2011**; University of Basel, Department of Chemistry, 25 August **2011**; 43rd IUPAC World Chemistry Congress, San Juan, Puerto Rico, July 31 – August 5, **2011**; University of Athens, Department of Chemistry, 28 May **2010**; Budapest University of Technology and Economics, meeting of the COST ACTION CM0802 "PHOSCINET", 27 March **2010**; 10th Hellenic Symposium Catalysis, Metsovo, 3-4 October **2008**; 2nd Swedish–Hellenic Life Science Research Conference, Athens, 18-19 October **2007**; Heinrich-Heine-Universität Düsseldorf, Institut für Organische und Makromolekulare Chemie, 9 July **2007**; Max-Planck-Institut für Kohlenforschung (Seminars in Reetz's group), Mülheim an der Ruhr, 4 June **2007**; 2nd Hellenic Symposium "Green Chemistry and Sustainable Development", Patras, 8-10 March **2007**; National Hellenic Research Foundation, Athens 21st November **2006**; 9th Hellenic Symposium Catalysis, Leukada, 6-7 October **2006**; Universität Leipzig, Fakultät für Chemie und Mineralogie, Leipzig 5th April **2006**; Aristotle University of Thessaloniki, Department of Chemistry, 14th March **2006**; 8th FIGIPAS Meeting in Inorganic Chemistry, Athens, 6-9 July **2005**; 1st Hellenic Symposium Organic Synthesis. From Chemistry to Biology, Medicine and Materials Science, Athens, November 4-6, **2004**; Concordia University, Department of Chemistry and Biochemistry, Montréal 22nd July **2004**; Université de Montréal, Département de Chimie, Montréal 21st July **2004**; Leibniz-Institut für Organische Katalyse an der Universität Rostock e.V., Rostock 2nd June **2003**; XVth Fechem Conference on Organometallic Chemistry, Zürich, Switzerland, August 10 - 15, **2003**; University of Athens – Department of Chemistry, 14th April **2003**; 19th Hellenic Chemistry

Conference, Heraklion-Crete November 6-10, **2002**; National Center for Scientific Research "Democritos", Institute of Physical Chemistry, Athens 9th November **2001**; University of Crete – Department of Chemistry, Heraklion 16th October **2001**; Russian Academy of Sciences – Siberian Branch, Favorsky Irkutsk Institute of Chemistry, Irkutsk 26th June **2001**; 6th Chemistry Conference of Greece-Cyprus, Rhodes, September 2-5, **1999**; 1st International Conference of the Chemical Societies of the South-East European Countries on Chemical Sciences and Industry, Halkidiki, Greece, June 1-4, **1998**; 2nd Symposium of the Institute of Physical Chemistry "Chemical Research and Industry", National Center for Scientific Research "Democritos", Athens December 3-5, **1997**; National Hellenic Research Foundation, Athens 6th February **1997**; 17th Greek Chemistry Conference, Patras December 1-5, **1996**; Max-Planck-Institut für Kohlenforschung (Seminars in Reetz's group), Mülheim an der Ruhr 30 October **1995**; Vrije Universiteit, Department of Chemistry, Amsterdam 26th January **1995**; University of Athens – Department of Chemistry, 21st October **1991**; Symposium of PhD students in Chemistry, National Center for Scientific Research "Democritos", Institute of Physical Chemistry, Athens October 16-18, **1989**.

Team members (former and/or current) directed by myself

(25) Perikleia Diamantopoulou, PhD student, 2021-present; (24) Electra Chomata, MSc student, 2021-present; (23) Eleftherios Ferentinos: Post-doc, 2019-2021; (22) Orfeas Marinakos: undergraduate student, Internship (2019); (21) Katerina Nasaj: MSc student, 2017-2018 (MSc/2019); (20) Rodolfos-Iosif Danalatos: undergraduate student, Internship (2017); (19) Marta Bartulewicz (Dublin Institute of Technology), Internship (Erasmus), 1.2.-31.7.2017; (18) Yakinthi Batsi: undergraduate student, Internship (2015), MSc 2016-2017 (MSc/2017), PhD student 2017-present; (17) Anastasia Eftychidou (University of Aberdeen/Department of Chemistry), Internship, 2015; (16) Alia-Cristina Tenchiu (Deleanu): PhD student, 2006-2010 (PhD/2012); post-doc, 2013-2015 & 2018; (15) Iro Ventouri, undergraduate student, 2014; (14) Georgia Ntasi, undergraduate student, 2014; (13) Helene Kalismaki: undergraduate student, Internship, 2013; (12) Olga Ventouri: undergraduate student, Internship, 2013; (11) Polydoros-Chrisovalantis Ioannou MSc student 2013 (MSc/2014) and PhD student (in collaboration with P. Kyritsis) 2015-2018 (PhD/2018), Post-doc 2019-2021; (10) Anastasia Pournara (in collaboration with D. Kovala-Demertzi): PhD student, 2011-2013 (PhD/2014); (9) Ioannis Stamatopoulos (in collaboration with P. Kyritsis): PhD student, 2011-2013 (PhD/2014); (8) Maria Kapsi (in collaboration with P. Kyritsis): MSc student, 2011 (MSc/2011); (7) Varvara Varda (chemist, MSc): 2010; (6) Dimitrios Giannitsios (in collaboration with P. Kyritsis): MSc student, 2009 (MSc/2009); (5) Christina Stangel (in collaboration with A. Coutsolelos): MSc student, 2009 (MSc/2010); (4) Dr. Ioannis Liratzis: Post-doc, 2006-2008; (3) Dr. Evangelos Tolis: Post-doc, 2004-2005; (2) Dr.

Fotini J. Andreadaki: Post-doc, 2003-2010; (1) Kalliopi A. Vallianatou: MSc and PhD student, 2002-2008, (MSc/2004, PhD/2008); "Leonidas Zervas" Prize in Organic Chemistry (5/3/2008); post-doc, 2010-2011;

Dr. Cécile Arbez-Gindre (Scientific Technical Staff, 2008-2016);

Dr. Georgia Antonopoulou (Scientific Technical Staff, 2009-present).

Former and/or current collaborations (outside NHRF)

National: Prof. Dr. A. Coutsolelos, University of Crete; Prof. Dr. G. Kokotos, University of Athens; Prof. Dr. D. Kovala-Demertzi, University of Ioannina; Asoc. Prof. Dr. P. Kyritsis, University of Athens; Prof. Dr. D.D. Leonidas, University of Thessaly; Dr. A. Terzis, Dr. C. Raptopoulou, Dr. V. Psycharis, NCSR "Democritos".

International: Prof. Dr. S.V. Amosova, Favorsky Irkutsk Institute of Chemistry (Russia); Prof. Dr. A. Börner, Leibniz-Institut für Katalyse an der Universität Rostock (Germany); Prof. Dr. G.S. Hanan, Université de Montréal (Canada); Prof. Dr. E. Hey-Hawkins, University of Leipzig (Germany); Prof. Dr. L. Kollár, University of Pécs and Szentágothai Science Center (Hungary); Prof. Dr. E. Monflier, Université d'Artois, Lens (France); Prof. Dr. A. Pfaltz, Universität Basel (Switzerland); Prof. Dr. M.T. Reetz/Director, Max-Planck-Institut für Kohlenforschung, Mülheim/Ruhr (Germany); Prof. Dr. J. Vohlídal, Charles University, Prague (Czech Republic).

Further Information

- *Development of research programs* in the field of transition metal homogeneous catalysis at the National Hellenic Research Foundation.
- *Member of the organizing committee and/or chair in conferences, workshops, educational events, e.g.* XXth International Conference on Organometallic Chemistry (2002), 11th Hellenic Symposium in Catalysis (2010), 5th and 11th NHRF – Örebro University Life Science Research Conference (2012 and 2018), workshop "Supragene" (2008), Workshop "Asymmetric Synthesis and Non-Conventional Advanced Synthetic Techniques for Fine Chemicals and Pharmaceuticals" (2010), educational event for the general public "Green Chemistry" (2014); Targeted Drug Discovery Workshop (2016).
- *Member of committees for MSc and PhD Theses* (K.A. Vallianatou, I. Stamatopoulos, D. Giannitsios, M. Kapsi, P.-C. Ioannou / Uni. Athens, A.-C. Tenchiu, A. Pournara, Y. Batsi / Uni. Ioannina, C. Stangel / Uni. Crete, K. Nasaj / Uni. Thessaloniki, C. Zotou, H. Karageorgou / Uni. Thessaly).
- *Member and Rapporteur in committees for recruitment and promotion* of Researchers and University Professors.
- *Member of the Internal Scientific Council* of the IOPC & IBMCB & ICB/NHRF for a number of years. Chairman of Internal Scientific Council: 2018-2020.

- Service to third parties.
- Exhibit of research presented at the *Thessaloniki International Fair* (Sept. 2014 & 2015).
- *Military service*: Special Forces, 1991-1993 (trainer in marines).
- Sports: Taekwon Do (black belt, 4th DAN).
- *Marital status*: Married, 2 children
- *Place – Year of Birth*: Karystos (Evia, Greece) – 1964.

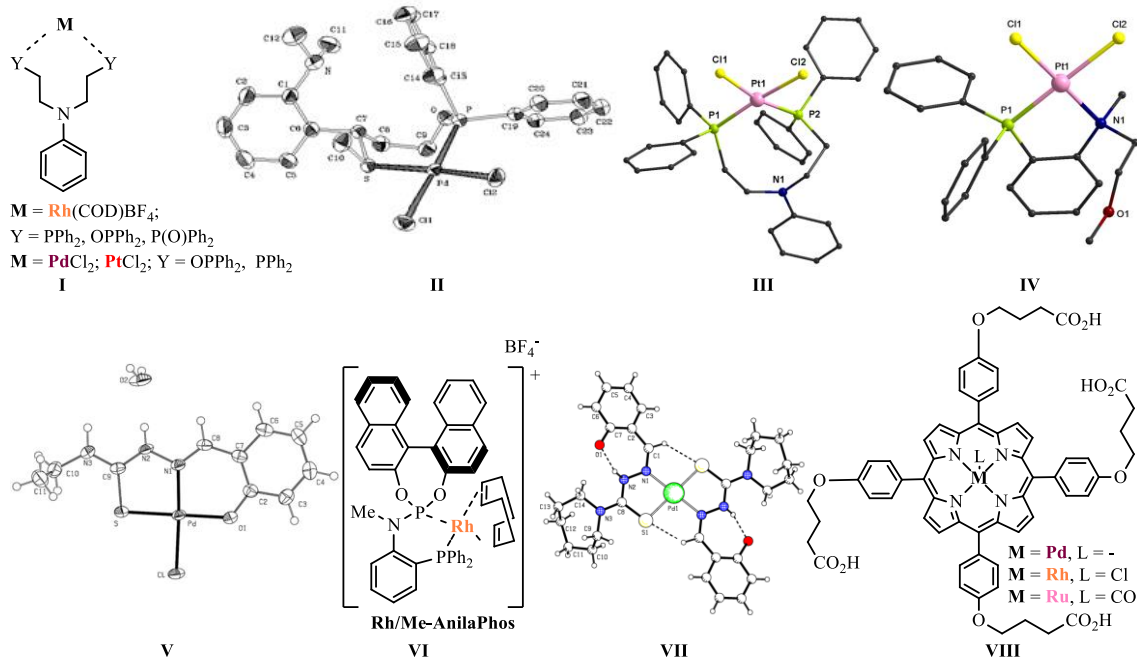
Recent Research Activities

TRANSITION-METAL HOMOGENEOUS CATALYSIS

Our investigations include the development of transition-metal (e.g. Ru, Rh, Pd, Pt) complexes with novel ligands and their evaluation as catalysts in reactions of enormous academic and industrial interest, such as hydroformylation, hydrogenation, coupling reactions (Heck, Suzuki). More specifically, our research activities include:

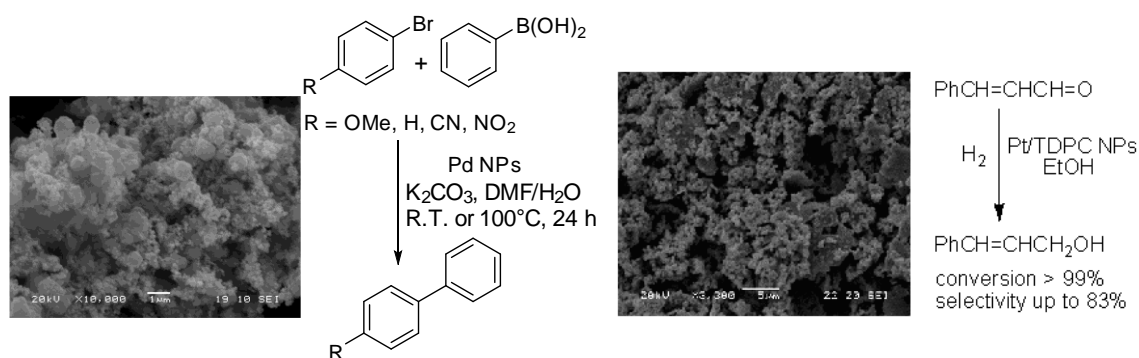
- (a) *Catalysis by hybrid and hemilabile phosphorus ligands* (e.g. phosphines, phosphine oxides, phosphinites, mixed phosphine-phosphinites) possessing additional potential donors such as oxygen, nitrogen, sulfur (e.g. I – IV).
- (b) *Catalysis in air by phosphane-free ligands* such as thiosemicarbazones (e.g. V, VII) and chalcogen-containing Schiff bases. We are pioneers in the use of thiosemicarbazones as catalyst precursors for palladium-catalyzed coupling reactions (Heck, Suzuki), under aerobic conditions, and one of our Pd complexes is commercially available from MERCK (SIGMA-ALDRICH) (Product No.: 674125) and other companies.
- (c) *Asymmetric catalysis* with new chiral amino diphosphite, phosphonite, phosphite-phosphoramidite and phosphine-phosphoramidite ligands, such as **Me-AnilaPhos** (VI) as a highly efficient ligand for the rhodium-catalyzed enantioselective olefin hydrogenation (100% conversion after 10 min at r.t. and 1 bar pressure, 98% ee).
- (d) *Catalysis by high energy techniques* such as microwave irradiation. This technique was used to the Suzuki coupling in air, catalyzed by a palladium complex with a thiosemicarbazone ligand (VII), which was totally inactive under conventional heating.
- (e) *Aqueous catalysis* offering environmental benefits and also the advantage of recycling and reusing the catalyst. We have published the first study concerning the evaluation of air-stable and water-soluble metalloporphyrins (VIII) in the Suzuki reaction and also the selective hydrogenation of unsaturated aldehydes in neat

water or in an aqueous/organic biphasic system. The catalysts could be easily recycled and reused.



CATALYSIS BY METAL NANOPARTICLES

We have synthesized metal nanoparticles (NPs) such as thiosemicarbazone-stabilised Pd NPs and Pt NPs using 3,3'-thiodipropionic acid as a protective agent as efficient catalysts for the Suzuki reaction and the selective hydrogenation of *trans*-cinnamaldehyde, respectively. The nanocatalysts could be recovered and reused.



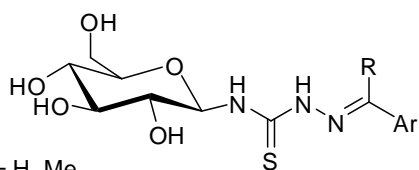
BIOLOGICALLY ACTIVE COMPOUNDS – MEDICINAL CHEMISTRY

The investigation includes the development of synthetic methodologies and synthesis of series of bioactive molecules for specific biological targets. In particular:

(a) *BRAFV600E* inhibitors. We have synthesized over 20 compounds (final products) such as new benzothiazole and indole derivatives containing amide or sulfonamide side-chains, some of which display promising inhibition selectivity towards *BRAFV600E* with IC_{50} down to 7.9 μM . Two of these compounds exhibit **strong anti-tumor action *in vivo***, while leaving unaffected normal cells.

(b) *Non-Steroidal Selective Glucocorticoid Receptor Agonists (SEGRA)*. We have designed and synthesized a series of modified imino-benzothiazole-thioacetamides, three of which, were shown to inhibit hydrocortisone-mediated transactivation probably by binding to GR and displacement of hydrocortisone. One of the compounds shows interesting results but simultaneously problems of toxicity and solubility, while another is found to have only an IC_{50} quite comparable to the hit compound.

(c) *Glycogen phosphorylase inhibitors*. We synthesized a series of β -D-glucopyranosyl-modified thiosemicarbazones, which found to be inhibitors of glycogen phosphorylase, a target for the design of type 2 diabetes therapeutics.

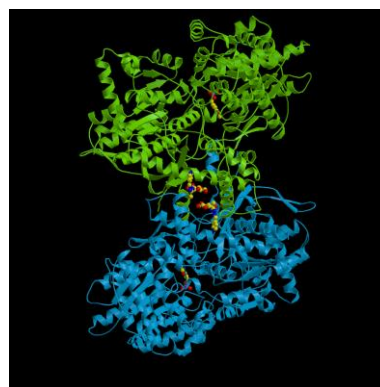
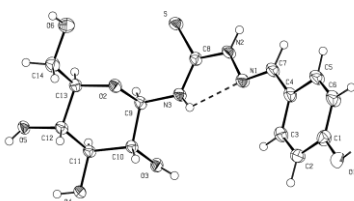


R = H, Me

Ar = -C₆H₄-X (*o,m,p*), pyridyl (2-,3-,4-), ferrocenyl, α -naphthyl

X = F, Cl, Br, CF₃, NO₂, OH, OMe, Me, *t*Bu

26 final products



Crystal structure of GP - glucose-thiosemicarbazone complex
15 crystal structures
 IC_{50} ~5 mM (minimum)

FUNDED PROGRAMS

Funded programs as COORDINATOR / SCIENTIST IN CHARGE

European programs:

- (1) Marie Curie Host Fellowships for the Transfer of Knowledge "Supramolecular chemistry and gene therapeutic potential of amine-substituted cyclodextrin end-functionalized triazine dendrimers based on melamine" (SUPRAGENE) (2006 – 2010, budget 331.4 K€ for our Institute).
- (2) Marie Curie Early Stage Training (EST) "A European Research Training Site for the Design and Synthesis of Novel Neuroprotective and Hypoglycaemic Agents through a Multi-disciplinary Approach" (EURODESY) (2006 – 2010, budget 984.1 K€ for our Institute, sub-coordinator since 2006 and coordinator after the initial coordinator "passed away").

National programs:

- (1) Program funded by the Mobility Program of the Greek National Youth Foundation "Contemporary Organic Chemistry and Applications" (6-16/5/1998; budget: 20.5 K€), training seminar for high school teachers.
- (2) Greece – Germany bilateral cooperation "New materials: Novel chiral nitrogen-containing phosphorus ligands for rhodium-catalyzed enantioselective hydroformylation" (2002-2004; budget: 15.4 K€ for our Institute). Partners: National Hellenic Research Foundation (Dr. I.D. Kostas), Leibniz-Institut für Organische Katalyse e.V. (Prof. Dr. A. Börner), Project House Catalysis of Degussa AG (Dr. Axel Monsees).
- (3) A competitive GSRT project for the commercial exploitation of research results "Commercialization of new systems for the applied homogeneous catalysis" (2003-2005; budget: 44 K€ for our Institute).
- (4) Greece – Canada bilateral cooperation "Polymetallic hemilabile dendritic nanocatalysts. Synthesis, characterization and applications" (2002-2005; budget: 59.9 K€ for our Institute). Partners: National Hellenic Research Foundation (Dr. I.D. Kostas), Université de Montréal, Département de chimie (Prof. Dr. G.S. Hanan).
- (5) Support of Young Researchers – Call B', ESPA 2014-2020, "Aqueous Asymmetric Homogeneous Catalysis" (2020-2021, budget 50 K€).
- (6) National Scholarships Foundation (IKY), Fellowship for the PhD student Yakinthi Batsi supervised by I.D. Kostas, "New heterocyclic derivatives as potential inhibitors of BRAF^{V600E}" (2018-2021; budget: 29.4 K€).
- (7) Internal programme with a budget constituted by the residues matching funds of the EU programmes REGPOT "ARCADE", TOK Marie Curie "SUPRAGENE", and EST Marie Curie "EURODESY", "Design and synthesis of functional compounds with catalytic and/or bioapplications (IDK)" (2019-present; budget: 31.2 K€).

Funded programs as MEMBER AND/OR SCIENTIST IN CHARGE IN TASKS OF THE PROJECT

European programs:

- (1) FP7-REGPOT-2009-1 "Advancement of Research Capability for the Development of New Functional Compounds" (ARCADE) (2010–2013, budget: 2,45 M€ for our Institute).
- (2) COST action CM0802: European Phosphorus Sciences Network (PhoSciNet) (2009 – 2013). member of the Management Committee (Greek representative).

National programs:

- (1) Greece-Russia bilateral cooperation "Design and synthesis of hemilabile ligands for homogeneous catalysis" (1999 – 2001, budget: 12.9 K€ for our Institute).

- Partners: National Hellenic Research Foundation, Favorsky Irkutsk Institute of Chemistry, Siberian Branch of Russian Academy of Sciences.
- (2) A competitive GSRT project for the commercial exploitation of research results "New high added-value products" (2002-2004; budget: 44 K€ for our Institute).
 - (3) Greece-Russia bilateral cooperation "Novel catalysts for industrially important chemical processes" (2002 – 2004, budget: 12.3 K€ for our Institute). Partners: National Hellenic Research Foundation, Favorsky Irkutsk Institute of Chemistry, Siberian Branch of Russian Academy of Sciences.
 - (4) Excellence in the Research Institutes supervised by the GSRT "Novel strategies against neurodegeneration" (2002–2005, budget: 200 K€ for our Institute).
 - (5) ARCHIMEDES: research in Technological Educational Institutes "Study of the metabolism of Vitamin A in liver diseases" (2003 – 2006).
 - (6) PYTHAGORAS: research in Universities "Development of the model structure – properties in bis(thiosubstituted) complexes. Synthesis and applications to transition-metal catalysis and photocatalysis" (2004 – 2006).
 - (7) Programme for the Promotion of the Exchange and Scientific Cooperation between Greece and Germany, IKYDA "Catalytically active rhodium, palladium and zinc complexes with sterically demanding hemilabile P,N–ligands" (2005 – 2006). Partners: National Hellenic Research Foundation, University of Leipzig.
 - (8) A competitive GSRT program EPAN – Action 4.5/4.5.1 "Design and synthesis of new bioactive molecules" (2005 – 2008, budget: 1.125 M€ for our Institute).
 - (9) Excellence in the Research Institutes supervised by the GSRT, 2nd cycle "Design and synthesis of new bioactive and functional molecules" (2005 – 2008, budget: 97.2 K€ for our Institute).
 - (10) HERAKLEITOS II, Greek Ministry of Education, Life Long Learning and Religious Affairs "Synthesis, characterization and study of the catalytic activity of complexes $M(P,P)X_2$, $M(E,P)X_2$ and $M(E,E)X_2$; $M= Ni, Pd, Pt$; $E=O, S, Se$; $X=Cl, Br$ " (2010 – 2013).
 - (11) Developmental proposals of research institutions – KRIPIS "Targeted therapeutic approaches against degenerative diseases, with emphasis on cancer and aging" (STHENOS) (2014 – 2016), budget: 1.5 M€ for our Institute.
 - (12) Developmental proposals of research institutions – KRIPIS "STHENOS-b: Targeted therapeutic approaches against degenerative diseases with special focus on cancer and ageing-optimisation of the targeted bioactive molecules" (2017 – 2020), budget: 750 K€ for our Institute.
 - (13) EPANEK 2014 – 2020 Strengthening Research and Innovation Infrastructure "OPENSREEN-GR", budget: 237,5 K€ for our Institute.

PUBLICATIONS (*as main author with a few exceptions*)Theses

2. **I.D. Kostas*** "Metal alkoxide modified organolithium reagents. Synthesis and stabilization of substituted lithioxyalkylolithiums including the aza-analogues, in tetrahydrofuran, in the presence of magnesium 2-ethoxyethoxide" (in Greek). *PhD Thesis*, National and Kapodistrian University of Athens, Athens **1991**.
1. **I.D. Kostas*** "1,3-Dipolar cycloaddition of nitrile oxides to 2,6-dibenzylidenecyclohexanone" (in Greek). *Undergraduate Thesis*, Aristotle University of Thessaloniki, Thessaloniki **1991**.

Books

2. **I.D. Kostas (Editor)** "Transition Metal Catalyzed Cross-Coupling Reactions". Printed Edition of the Special Issue Published in *Catalysts*, MDPI, Basel, First Edition **2021**. <https://www.mdpi.com/books/pdfview/book/4714>, <https://doi.org/10.3390/books978-3-0365-2576-1>
1. **I.D. Kostas (Editor)** "Suzuki–Miyaura Cross-Coupling Reaction and Potential Applications". Printed Edition of the Special Issue Published in *Catalysts*, MDPI, Basel, First Edition **2017**. <https://doi.org/10.3390/books978-3-03842-557-1>

Book Chapters

4. **I.D. Kostas*** "Recent Advances in P,N-Containing Ligands for Transition-Metal Homogeneous Catalysis". In *Advances in Organic Synthesis*, Atta-ur-Rahman, FRS (Ed.), Bentham Science, **2013**, Vol. 6, pp. 3-58. **Invited book chapter**. <https://doi.org/10.2174/9781608050291113060003>, <https://ebooks.benthamscience.com/book/9781608050291/>
3. **I.D. Kostas*** "Other P/N-Ligands". In *Phosphorus Ligands in Asymmetric Catalysis – Synthesis and Applications*, A. Börner (Ed.), Wiley-VCH, Weinheim, **2008**, vol. 2, part IV, chapter 1.2, pp. 596-632. **Invited book chapter**. <http://eu.wiley.com/WileyCDA/WileyTitle/productCd-3527317465.html>
2. N.G. Oikonomakos*, M.N. Kosmopoulou, D.D. Leonidas, E.D. Chrysina, C. Tiraidis, N. Bischler, K.E. Tsitsanou, S.E. Zographos, **I.D. Kostas**, G. Eisenbrand "Indirubin and indigo analogues as potential inhibitors of glycogenolysis: structural basis of glycogen phosphorylase inhibition". In *Indirubin, the red shape of indigo*, L. Meijer, N. Guyard, L.A. Skaltsounis, G. Eisenbrand (eds.). Editions "Life in Progress", Roscoff, **2006**, Chapter 18, 177-189.
1. **I.D. Kostas*** "Applied Homogeneous Catalysis". In *Contemporary Organic Chemistry and Applications* (in Greek), National Hellenic Research Foundation, Institute of Organic and Pharmaceutical Chemistry, Athens **1998**, pp. 27-48.

Guest Editor of Special Issues

2. *CATALYSTS* (Academic Editor: Ioannis D. Kostas), Special Issue "Transition Metal Catalyzed Cross-Coupling Reactions" **2020**.
https://www.mdpi.com/journal/catalysts/special_issues/cross_coupl_react
1. *CATALYSTS* (Academic Editor: Ioannis D. Kostas), Special Issue "Suzuki–Miyaura Cross-Coupling Reaction and Potential Applications". Papers were published during **2016-2017**.
https://www.mdpi.com/journal/catalysts/special_issues/suzuki_miyaura

Editorials

1. **I.D. Kostas*** *Catalysts* **2021**, *11* (4), 473, 1–2 "Editorial Catalysts: Special Issue on Transition Metal Catalyzed Cross-Coupling Reactions".
<https://doi.org/10.3390/catal11040473>

Publications in refereed journals

47. **I.D. Kostas***, B.R. Steele* *Catalysts* **2020**, *10* (10), 1107, 1–40 "Thiosemicarbazone Complexes of Transition Metals as Catalysts for Cross-Coupling Reactions" <https://doi.org/10.3390/catal10101107>
46. P.-C. Ioannou, C. Arbez-Gindre, M. Zoumpantioti, C. P. Raptopoulou, V. Psycharis, **I. D. Kostas***, P. Kyritsis* *J. Organomet. Chem.* **2019**, *879*, 40–46 "Catalytic reactivity of the complexes $[\text{Pd}\{(\text{Ph}_2\text{P})_2\text{N}(\text{tBu})\text{-}P,P\}\text{X}_2]$, X = Cl, Br, I, in the Suzuki-Miyaura C–C coupling reaction: Probing effects of the halogeno ligand X[−] and the ligand's tBu group". <https://doi.org/10.1016/j.jorganchem.2018.10.006>
45. I.K. Stamatopoulos, M. Kapsi, M. Roulia, G.C. Vougioukalakis, C.P. Raptopoulou, V. Psycharis, **I.D. Kostas***, L. Kollár*, P. Kyritsis* *Polyhedron* **2018**, *151*, 292–298 "Structural features and catalytic reactivity of $[\text{Pd}\{(\text{Ph}_2\text{P})_2\text{N}(\text{CH}_2)_3\text{Si}(\text{OCH}_3)_3\text{-}\kappa\text{P},P'\}\text{I}_2]$ and related complexes in hydroalkoxycarbonylation and Suzuki-Miyaura C–C cross-coupling reactions". <https://doi.org/10.1016/j.poly.2018.05.041>
44. I. Stamatopoulos, M. Roulia, K.A. Vallianatou, C.P. Raptopoulou, V. Psycharis, M. Carravetta, C. Papachristodoulou, E. Hey-Hawkins, **I.D. Kostas***, P. Kyritsis* *ChemistrySelect* **2017**, *2* (36), 12051-12059 "Immobilization of $[\text{Pd}\{(\text{Ph}_2\text{P})_2\text{N}(\text{CH}_2)_3\text{Si}(\text{OCH}_3)_3\text{-}\kappa\text{P},P'\}\text{X}_2]$ (X=Cl, Br) onto Montmorillonite: Investigating their Performance as Homogeneous or Heterogenized Suzuki-Miyaura Catalysts". <https://doi.org/10.1002/slct.201702601>
43. **I.D. Kostas***, G. Antonopoulou, C. Potamitis, C.P. Raptopoulou, V. Psycharis *J. Organomet. Chem.* **2017**, *828*, 133-141 "Platinum Complexes with a methoxy-amino phosphine or a nitrogen-containing bis(phosphine) ligand. Synthesis,

- characterization and application to hydrogenation of *trans*-cinnamaldehyde".
<https://doi.org/10.1016/j.jorganchem.2016.11.036>
42. A.-C. Tenchiu, I.-K. Ventouri, G. Ntasi, D. Palles, G. Kokotos, D. Kovala-Demertzi, **I.D. Kostas*** *Inorg. Chim. Acta* **2015**, *435*, 142-146 "Synthesis of a palladium complex with a β -D-glucopyranosyl-thiosemicarbazone and its application in the Suzuki-Miyaura coupling of aryl bromides with phenylboronic acid"
<https://doi.org/10.1016/j.ica.2015.06.019>
41. **I.D. Kostas***, A.-C. Tenchiu, C. Arbez-Gindre, V. Psycharis, C.P. Raptopoulou *Catal. Commun.* **2014**, *51*, 15-18 "Room-temperature Suzuki-Miyaura coupling of aryl bromides with phenylboronic acid catalyzed by a palladium complex with an inexpensive nitrogen-containing bis(phosphinite) ligand"
<https://doi.org/10.1016/j.catcom.2014.03.014>
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39. K.A. Vallianatou, D.J. Frank, G. Antonopoulou, S. Georgakopoulos, E. Siapi, M. Zervou, **I.D. Kostas*** *Tetrahedron Lett.* **2013**, *54*(5), 397-401 "Rhodium-catalyzed asymmetric olefin hydrogenation by easily accessible aniline- and pyridine-derived chiral phosphites". <https://doi.org/10.1016/j.tetlet.2012.11.023>
38. P. Pongrácz, **I.D. Kostas**, L. Kollár* *J. Organomet. Chem.* **2013**, *723*, 149-153 "Platinum complexes of *P,N*- and *P,N,P*-ligands and their application in the hydroformylation of styrene". <https://doi.org/10.1016/j.jorganchem.2012.10.018>
37. C. Stangel, G. Charalambidis, V. Varda, A.G. Coutsolelos,* **I.D. Kostas*** *Eur. J. Inorg. Chem.* **2011**, (30), 4709-4716 "Aqueous–Organic Biphasic Hydrogenation of *trans*-Cinnamaldehyde Catalyzed by Rhodium and Ruthenium Phosphane-Free Porphyrin Complexes". <https://doi.org/10.1002/ejic.201100668>
36. K.-M. Alexacou, A.-C. Tenchiu (Deleanu), E.D. Chrysina, M.-D. Charavgi, **I.D. Kostas***, S.E. Zografos, N.G. Oikonomakos, D.D. Leonidas* *Bioorg. Med. Chem.* **2010**, *18*(22), 7911-7922 "The binding of β -D-glucopyranosyl-thiosemicarbazone derivatives to glycogen phosphorylase: A new class of inhibitors"
<https://doi.org/10.1016/j.bmc.2010.09.039>
35. A.-C. Tenchiu (Deleanu), **I.D. Kostas***, D. Kovala-Demertzi, A. Terzis *Carbohydr. Res.* **2009**, *344*(11), 1352-1364 "Synthesis and characterization of new aromatic aldehyde/ketone 4-(β -D-glucopyranosyl)thiosemicarbazones"
<https://doi.org/10.1016/j.carres.2009.05.010>
34. **I.D. Kostas***, F.J. Andreadaki, E.A. Medlycott, G.S. Hanan, E. Monflier *Tetrahedron Lett.* **2009**, *50*(16), 1851-1854 "Synthesis of a halo-methylphenylene periphery-

- functionalized triazine-based dendritic molecule with a 3,3'-dimethyl-biphenyl linker using tris(halo-methylphenylene)triazines as building blocks"
<https://doi.org/10.1016/j.tetlet.2009.02.011>
33. **I.D. Kostas*** *Curr. Org. Synth.* **2008**, *5*(3), 227-249 "Recent Advances on P,N-Containing Ligands for Transition-Metal Homogeneous Catalysis". **Invited Article**.
<https://doi.org/10.2174/157017908785133447>
32. D. Kovala-Demertzi*, N. Kourkoumelis*, K. Derlat, J. Michalak, F.J. Andreadaki, **I.D. Kostas*** *Inorg. Chim. Acta* **2008**, *361*(5), 1562-1565 "Thiosemicarbazone-derivatised palladium nanoparticles as efficient catalyst for the Suzuki-Miyaura cross-coupling of aryl bromides with phenylboronic acid"
<https://doi.org/10.1016/j.ica.2007.09.038>
31. **I.D. Kostas***, K.A. Vallianatou, J. Holz, A. Börner* *Tetrahedron Lett.* **2008**, *49*(2), 331-334 "A new easily accessible chiral phosphite-phosphoramidite ligand based on 2-anilinoethanol and *R*-BINOL moieties for Rh-catalyzed asymmetric olefin hydrogenation" <https://doi.org/10.1016/j.tetlet.2007.11.049>
30. **I.D. Kostas***, A.G. Coutsolelos*, G. Charalambidis, A. Skondra *Tetrahedron Lett.* **2007**, *48*(38), 6688-6691 "The first use of porphyrins as catalysts in cross-coupling reactions: a water-soluble palladium complex with a porphyrin ligand as an efficient catalyst precursor or the Suzuki-Miyaura reaction in aqueous media under aerobic conditions" <https://doi.org/10.1016/j.tetlet.2007.07.141>
29. K.A. Chatziapostolou, K.A. Vallianatou, A. Grigoropoulos, C.P. Raptopoulou, A. Terzis, **I.D. Kostas***, P. Kyritsis*, G. Pneumatikakis *J. Organomet. Chem.* **2007**, *692*(19), 4129-4138 "Synthesis and characterization of new Rh^I complexes bearing CO, PPh₃ and chelating *P,O*- or *Se,Se*-ligands. Application to hydroformylation of styrene" <https://doi.org/10.1016/j.jorganchem.2007.06.032>
28. K.A. Vallianatou, **I.D. Kostas***, J. Holz, A. Börner *Tetrahedron Lett.* **2006**, *47*(45), 7947-7950 "Me-AnilaPhos: A new chiral phosphine-phosphoramidite ligand for a highly efficient Rh-catalyzed asymmetric olefin hydrogenation"
<https://doi.org/10.1016/j.tetlet.2006.08.136>
27. **I.D. Kostas***, B.R. Steele*, A. Terzis, S.V. Amosova, A.V. Martynov, N.A. Makhaeva *Eur. J. Inorg. Chem.* **2006**, (13), 2642-2646 "New Palladium Complexes with S- or Se-Containing Schiff-Base Ligands as Efficient Catalysts for the Suzuki-Miyaura Cross-Coupling Reaction of Aryl Bromides with Phenylboronic Acid under Aerobic Conditions" <https://doi.org/10.1002/ejic.200600180>
26. **I.D. Kostas***, G.A. Heropoulos*, D. Kovala-Demertzi*, P.N. Yadav, J.P. Jasinski, M.A. Demertzis, F.J. Andreadaki, G. Vo-Thanh, A. Petit, A. Loupy *Tetrahedron Lett.* **2006**, *47*(26), 4403-4407 "Microwave-promoted Suzuki-Miyaura cross-coupling of aryl halides with phenylboronic acid under aerobic conditions catalyzed by a new palladium complex with a thiosemicarbazone ligand"

- <https://doi.org/10.1016/j.tetlet.2006.04.088>
25. E.I. Tolis, K.A. Vallianatou, F.J. Andreadaki, **I.D. Kostas*** *Appl. Organomet. Chem.* **2006**, *20*(5), 335-337 "A new rhodium complex with a nitrogen-containing bis(phosphine oxide) ligand as an efficient catalyst for the hydroformylation of styrene" <https://doi.org/10.1002/aoc.1057>
24. N.V. Dubrovina*, V.I. Tararov, A. Monsees, A. Spannenberg, **I.D. Kostas**, A. Börner* *Tetrahedron: Asymmetry* **2005**, *16*(22), 3640-3649 "New chiral 1,3-diphosphine ligands for Rh-catalyzed enantioselective hydrogenation: a search for electronic effects" <https://doi.org/10.1016/j.tetasy.2005.08.048>
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22. N.G. Oikonomakos*, M.N. Kosmopoulou, E.D. Chrysinia, D.D. Leonidas, **I.D. Kostas**, K.U. Wendt, T. Klabunde, E. Defossa *Protein Sci.* **2005**, *14*(7), 1760-1771 "Crystallographic studies on acyl ureas, a new class of glycogen phosphorylase inhibitors, as potential antidiabetic drugs" <https://doi.org/10.1110/ps.051432405>
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20. **I.D. Kostas***, F.J. Andreadaki, D. Kovala-Demertzi*, C. Prentjas, M.A. Demertzis *Tetrahedron Lett.* **2005**, *46*(12), 1967-1970 "Suzuki-Miyaura cross-coupling reaction of aryl bromides and chlorides with phenylboronic acid under aerobic conditions catalyzed by palladium complexes with thiosemicarbazone ligands" <https://doi.org/10.1016/j.tetlet.2005.02.003>
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16. D. Kovala-Demertzi*, P.N. Yadav, M.A. Demertzis, J.P. Jasiski, F.J. Andreadaki, **I.D. Kostas*** *Tetrahedron Lett.* **2004**, 45(14), 2923-2926 "First use of a palladium complex with a thiosemicarbazone ligand as catalyst precursor for the Heck reaction" <https://doi.org/10.1016/j.tetlet.2004.02.062>
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