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Introduction to hypervalent iodine chemistry. Part 3

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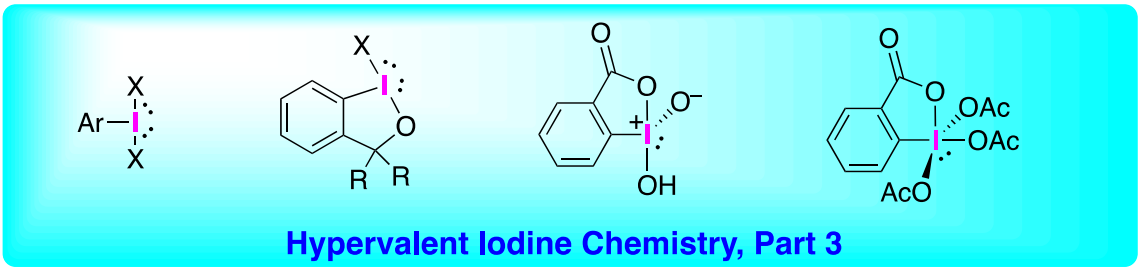
This special issue of Arkivoc is for "Hypervalent Iodine Chemistry"

This short overview provides a brief introduction to Part 3 of the Arkivoc series of issues on Hypervalent Iodine (HI) Chemistry. A summary of topics covered in the 2020 and 2021 HI issues of Arkivoc is provided and recent literature reviews on Hypervalent Iodine Chemistry are referenced. Hypervalent iodine reagents and catalysts are intensively used in modern organic chemistry as mild, environmentally safe, and economical alternative to heavy metal reagents.



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Part 1 of the Arkivoc series of issues on Hypervalent Iodine (HI) Chemistry was published in spring 2020 in connection with the 7th International Conference on Hypervalent Iodine Chemistry (ICHIC-2020).[1] The conference was initially moved to 2021 because of the pandemic and later it was cancelled (http://www.ichic2020.ru/index.php/en/). Part 1 (2020) and Part 2 (2021) contain total 20 papers covering a broad range of topics of the HI chemistry. Specific topics of these papers include the following: theoretical and computational studies of HI compounds,[2-4] structural studies,[5] development of new synthetic approaches to HI reagents,[6-9] photochemical reactions involving HI chemistry,[10,11] industrial applications of hypervalent polyiodides,[12] and numerous synthetic applications of HI reagents.[13-20] Part 3 of the HI series will be published in 2022 covering all topics of iodine chemistry involving hypervalent species and halogen bonding.

In our introductory overview "Hypervalent iodine compounds: reagents of the future" published in Part 1, about one hundred of books and major reviews on HI chemistry published through 2019 were cited.[1] Since then, just in two years, between winter 2020 and spring 2022, about 60 major reviews dedicated to different aspects of HI chemistry have been published.[10-12,15,18,19,21-61] Very recently, in spring 2022, an excellent, comprehensive book "Iodine Catalysis in Organic Synthesis" edited by Ishihara and Muñiz and covering the dynamic area of hypervalent iodine catalysis was published.[62] The development of highly efficient, enantioselective molecular catalysts based on the unique redox and photoredox chemistry of iodine has been one of the most impressive recent achievements in the field of HI chemistry.[11,18,26,36,46,48,61]

Numerous synthetic methodologies are based on the very useful oxidizing properties of HI reagents, combined with their benign environmental character and commercial availability. The use of hypervalent iodine species for the coupling reactions leading to new carbon-carbon bonds was surveyed in two reviews.[47,57] Applications of iodine(III) reagents in the synthesis of heterocycles was summarized in numerous reviews.[15,44,45,49,51,53,56] The HI based methodologies have found wide application in the synthesis of natural products.[25,41,44,48]

Several recent reviews have been dedicated to synthetic applications of specific classes of hypervalent iodine compounds. Aryliodonium salts have attracted significant interest as electrophilic arylating reagents.[37,43] Hypervalent iodine organosulfonates have found wide application as powerful electrophiles and oxidizing reagents.[23,31,61] The development of new synthetic methodologies and the use of hypervalent iodine reagents in specific classes of reactions have attracted significant research activity. In particular, radical and photochemical reactions of hypervalent iodine compounds have become one of the hottest areas of modern hypervalent iodine chemistry.[10,36] New methods for generation of hypervalent iodine compounds using green chemistry approaches have recently been developed. In particular, the electrochemical oxidation of iodoarenes can serve as efficient method for the generation of hypervalent iodine reagents, eliminating the necessity to use hazardous chemical oxidants.[34,35] The industrial applications of hypervalent iodine chemistry were summarized in two reviews.[12,24]

In conclusion, this brief survey of recently published reviews demonstrates increasing research activity in different areas of hypervalent iodine chemistry. Hypervalent iodine reagents and synthetic methodologies involving hypervalent iodine species have become essential tools of modern organic synthesis. We anticipate that the inspiring chemistry of hypervalent iodine compounds will continue to attract significant interest and research activity in the future.

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Author's Biography

Viktor V. Zhdankin was born in Ekaterinburg, Russian Federation. His M.S. (1978), Ph.D. (1981), and Doctor of Chemical Sciences (1986) degrees were earned at Moscow State University. He moved to the University of Utah in 1990, where he worked for three years as Instructor of organic chemistry and Senior Research Associate with Professor Peter J. Stang. In 1993, he joined the faculty of the University of Minnesota Duluth, where he is currently a Professor of Chemistry. Dr. Zhdankin has published more than 300 research papers, gave over a hundred research presentations in many countries, edited several books, co-authored the *Handbook of Heterocyclic Chemistry* (3rd Edition, 2010) with Professors A. R. Katritzky, C. A. Ramsden, and J. A. Joule, and authored a book on *Hypervalent Iodine Chemistry* (Wiley, 2013). He has also published a general introductory textbook on *Organic Chemistry* (Cognella, 2018, https://titles.cognella.com/organic-chemistry-9781634878999). His main research interests are in the areas of synthetic and mechanistic organic chemistry of hypervalent main-group elements and organofluorine chemistry. In 2011 he received the National Award of the American Chemical Society for *Creative Research & Applications of Iodine Chemistry*. Since 2003 he is Scientific Editor and a Member of Control Board of *Arkivoc*.