Inorganic Chemistry

Editorial

pubs.acs.org/IC

Forums on Small-Molecule Activation: from Biological Principles to Energy Applications

Molecules such as O_2, N_2, H_2, CO_2, N_2O, and CH_4 are small but beautiful, pervasive, and impactful. They are critical players in various biogeochemical cycles, and several of them play a key role in climate change and other environmentally important issues. Organisms make use of them in various metabolic processes such as respiration and photosynthesis, and many of these small molecules are also produced or converted on large scales in the chemical industry. Because they are involved in elementary reactions relevant to the efficient and reversible storage of energy in, and release of energy from, chemical bonds, they are integral to all technological scenarios for postfossil energy systems and for a more sustainable society. As a consequence, massive efforts are being devoted to converting those small molecules into high-value chemical feedstocks and fuels. Mastering the chemistry of those molecules represents a prime challenge of the 21st century.

While molecules like O_2, N_2, CO_2, NH_3, and CH_4 are indeed abundant and readily accessible, most of them are largely inert, and their chemical transformations are thermodynamically demanding and mechanistically complex. In many cases, such transformations involve multielectron redox processes, coupled with proton transfers, via reaction pathways that are difficult to control. Unravelling the mechanistic basis and operational principles of such reactions represents a formidable challenge to the chemical sciences, and addressing these challenges is essential for the design and development of efficient catalysts. Because nature mostly uses metal ions to activate these relatively inert molecules and modulate their reactivity, much inspiration for the field has come from bioinorganic chemistry. However, unifying views of small-molecule transformations encompassing enzymatic reactions and homogeneous organometallic chemistry and heterogeneous catalysis are now starting to emerge, and photo- and electrocatalysis are central to efforts to convert other forms of energy into chemical fuels. In the chemistry of these small molecules, simplicity meets complexity!

It thus seemed timely to gather some of the excitement and recent advances in the field of small-molecule activation and reactivity in focused research overviews featured in *Inorganic Chemistry* Forums. These Forums are not meant to comprise comprehensive reviews of all manifold activities going on in the arena but rather to feature a series of pointed accounts of key accomplishments and challenges contributed by leading experts from around the world. We are pleased to introduce this "Forum of Forums", consisting of a cohesive set of three individual Forums published during 2015 and organized by sets of small-molecule targets. Each individual Forum has been organized by two renowned guest editors, who aim to highlight key achievements and address important research questions. The emphasis of the first of these Forums, guest edited by Etsuko Fujita and Alan Goldman, is on small molecules related to carbonaceous fuels, such as CO_2, CO, and CH_4. This will be followed by a Forum on small molecules of the global nitrogen cycle, including N_2, NH_3, N_2O, and NO, with guest editors Nicolai Lehnert and Jonas Peters. The series will be concluded with a Forum focused on small molecules related to (artificial) photosynthesis, such as H_2, O_2, and H_2O, guest edited by Marcetta Darensbourg and Antoni Llobet. More specific information about the themes and articles of each collection will be presented by the guest editors in their articles prefacing each individual Forum.

We thank our guest editors for dedicating their valuable time to this endeavor and for bringing together such a splendid series of articles. Thanks also go to the authors for their contributions and to the reviewers for their helpful comments! The deep insights provided in these articles are truly inspirational, and we hope that you, our readers, enjoy them as much as we have.

Franc Meyer
William B. Tolman

AUTHOR INFORMATION

Notes

Views expressed in this editorial are those of the author and not necessarily the views of the ACS.

Published: June 1, 2015

ACS Publications © 2015 American Chemical Society

DOI: 10.1021/acs.inorgchem.5b00768
Inorg. Chem. 2015, 54, 5039−5039