

Успехи химии

Том 93
Номер 6
2024

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Russian Chemical Reviews

Volume 93 Number 6 2024

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Proton exchange membrane fuel cells: processes – materials – design in current trends

RCR5121

A.A.Belmesov, L.V.Shmygleva, A.A.Baranov, A.V.Levchenko

*Federal Research Center of Problems of Chemical Physics and Medicinal Chemistry
of the Russian Academy of Sciences, Chernogolovka, Moscow Region, Russian Federation*

Over the last decade, the potential of proton exchange membrane fuel cells (PEMFCs) for use in a range of applications, including automotive transport, has attracted the attention of scientific groups and industry representatives worldwide. The active development of PEMFCs is already enabling them to compete with internal combustion engines and lithium-ion batteries in a number of applications. However, significant improvements in a number of PEMFCs characteristics are required to expand the scope of their applications. This review is intended to bridge the gap between existing reviews, which are either overly general or overly specific, and provide a comprehensive overview of the current state of the art and potential future applications of PEMFCs. It will focus on the main components of PEMFCs, including proton exchange membranes, catalytic and gas diffusion layers, bipolar plates, and cooling systems, and the factors affecting the PEMFC performance.

Bibliography — 428 references.

Direct site-selective C(sp³)–H functionalization of unprotected non-activated alcohols RCR5123

V.Aggarwal,^a A.Kachore,^a E.Bala,^a H.Singh,^a S.Malik,^a M.Selvaraj,^{b,c} M.A.Assiri,^{b,c}
P.K.Verma,^{a,d} U.Sharma^e

^a *School of Advanced Chemical Sciences, Shoolini University of Biotechnology and Management Sciences,
Solan, H.P., India*

^b *Department of Chemistry, Faculty of Science, King Khalid University, Abha, Saudi Arabia*

^c *Research Centre for Advanced Materials Science, King Khalid University, Abha, Saudi Arabia*

^d *Department of Oral and Maxillofacial Surgery, Saveetha Dental College and Hospitals, SIMATS, Saveetha University,
Chennai, Tamil Nadu, India*

^e *C–H Activation & Phytochemistry Lab, Chemical Technology Division, CSIR-Institute of Himalayan Bioresource
Technology, Palampur, Himachal Pradesh, India*

Free alcohols are ubiquitous in nature, drugs, bulk chemicals, and various complex molecules. The abundantly available free aliphatic alcohols, being inexpensive, are sustainable starting materials in organic synthesis to construct value-added scaffolds. Direct C(sp³)–H functionalization of inert bonds in aliphatic alcoholic chain is challenging due to their inactive nature towards chemical reactions and also multiple similar C–H bonds are available for functionalization reaction at a time. Barton process, which is a classical method for generating alkoxyl radicals, has been widely used for the remote functionalization of alcoholic chain using the strategy of 1,5-hydrogen atom transfer (1,5-HAT). However, the requirement for the pre-activation of alcohols not only adds extra and tedious steps but also, these precursors are challenging to prepare and handle. Generating desired alkoxyl radicals from these precursors is a difficult task and also affects the atom economy of reactions. Numerous methods covering the C(sp³)–H functionalization of unprotected non-activated alcohols at diverse (α , β -, γ -, δ -) positions to access functionalized alcohols are elaborated here. A precise and focused compilation will help to understand what has been established and how new methodologies can be developed for the future needs.

Bibliography — 158 references.

D.Yu.Voropaeva, I.A.Stenina, A.B.Yaroslavtsev

Kurnakov Institute of General and Inorganic Chemistry of the Russian Academy of Sciences, Moscow, Russian Federation

Currently, all-solid-state lithium metal batteries are considered among the most promising energy storage devices, due to their safety and high energy density. Solid-state electrolytes, the key components of the batteries, are attracting increasing attention. This review presents an analysis of important recent advances in the field of lithium conductive solid-state electrolytes, including the mechanisms of conductivity, the main approaches to increase the conductivity, optimization of interfaces and ways to improve the stability for the main types of electrolytes, *i.e.*, inorganic, polymer and composite materials. For solid inorganic electrolytes, high conductivity and stability have been achieved; however, the problems related the formation of dense thin films and formation of a reliable contact with electrode materials are still unsolved. Polymer electrolytes are characterized by lower conductivity, which is improved upon plasticization with aprotic solvents. Composite electrolytes, for which it is possible to achieve a combination of high conductivity and good mechanical properties along with stability, are considered as the most promising. The main problems in the field of solid electrolytes for all-solid-state lithium metal batteries and possible ways to solve them are outlined.

Bibliography — 661 references.

Design of targeted antiviral polypeptides, specific to SARS-CoV-2. Challenges and prospects**RCR5128**O.N.Shilova,^a E.S.Shilov,^b S.M.Deyev^{a,b}^a *Shemyakin–Ovchinnikov Institute of Bioorganic Chemistry, Russian Academy of Sciences, Moscow, Russian Federation*^b *Faculty of Biology, Lomonosov Moscow State University, Moscow, Russian Federation*

The COVID-19 epidemic demanded the rapid development of high-affinity molecules of different types aimed at a single target, the S-protein of SARS-CoV-2. The simultaneous development and testing of such molecules provide a unique opportunity to compare the features of biotechnological platforms for creating therapeutic proteins. This review considers classical antibodies, variable lymphocyte receptors, single-domain antibodies, and artificial scaffolds (DARpins, affibodies, VH), that are compared in terms of affinity, neutralizing activity, size and compatibility with different delivery methods. It can be concluded that all platforms used have produced high-affinity proteins that specifically bind to the coronavirus S-protein. The highest affinity of the targeting molecules with the virus protein was achieved by developing classical antibodies, nanobodies and by combining several binding modules into multivalent constructs with high avidity. Based on the results of *in vivo* experiments, it can be concluded that a high affinity of the therapeutic protein for the surface antigens of SARS-CoV-2 is a necessary but not sufficient condition for suppression of COVID-19 due to the peculiarities of the biology of this virus. The experience gained in the development of therapeutic agents against coronavirus will be useful for design of effective targeted drugs for the treatment of known and new viral infections.

Bibliography — 126 references.