



# Успехи химии

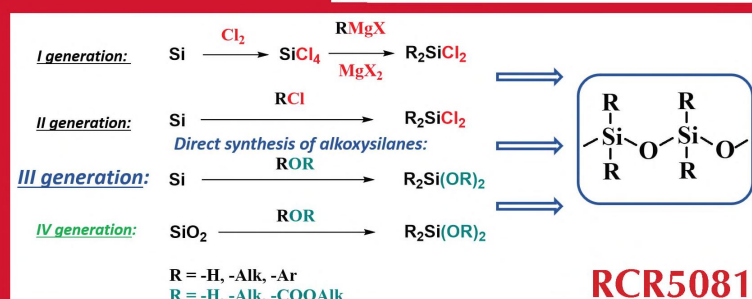


key component of future energy

**28 Ni Nickel**

- suitable redox potential
- low toxicity
- structure stability
- moderate reserve
- two-electron redox

**RCR5086**



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**RCR5086**

Никель — ключевой элемент энергетики будущего

# Russian Chemical Reviews

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### **Direct synthesis of alkoxy silanes: current state, challenges and prospects** RCR5081

M.N.Temnikov,<sup>a,b</sup> I.N.Krizhanovskiy,<sup>a,b</sup> A.A.Anisimov,<sup>a,b</sup> S.P.Bedenko,<sup>b,c</sup> K.I.Dementiev,<sup>b,c</sup> I.V.Krylova,<sup>d</sup> S.A.Milenin,<sup>a,e</sup> A.L.Maksimov,<sup>c</sup> M.P.Egorov,<sup>d</sup> A.M.Muzafarov<sup>b,e</sup>

<sup>a</sup> *L.N.Tolstoy Tula State Pedagogical University, Russia*

<sup>b</sup> *A.N.Nesmeyanov Institute of Organoelement Compounds, Russian Academy of Sciences, Moscow, Russia*

<sup>c</sup> *A.V.Topchiev Institute of Petrochemical Synthesis, Russian Academy of Sciences, Moscow, Russia*

<sup>d</sup> *N.D.Zelinsky Institute of Organic Chemistry, Russian Academy of Sciences, Moscow, Russia*

<sup>e</sup> *Enikolopov Institute of Synthetic Polymeric Materials, Russian Academy of Sciences, Moscow, Russia*

This review analyzes the current state of the art in the direct synthesis of alkoxy silanes. The main approaches, challenges and prospects of this process are highlighted. The plausible reaction mechanism is considered, as well as factors that have a significant influence on the process, among which temperature, type and concentration of the catalyst, promoter additives, the method of carrying out the process, *etc.*, can be mentioned.

Bibliography — 232 references.

### **Controlled ignition of low-carbon gas engine fuels based on natural gas and hydrogen: kinetics of the process** RCR5084

V.S.Arutyunov,<sup>a,b,c</sup> A.V.Arutyunov,<sup>a,b</sup> A.A.Belyaev,<sup>a</sup> K.Ya.Troshin<sup>a</sup>

<sup>a</sup> *N.N.Semenov Federal Research Centre for Chemical Physics, Russian Academy of Sciences, Moscow, Russia*

<sup>b</sup> *Lomonosov Moscow State University, Russia*

<sup>c</sup> *Federal Research Center of Problems of Chemical Physics and Medicinal Chemistry, Russian Academy of Sciences, Chernogolovka, Moscow Region, Russia*

The potential wide use of environmentally friendly low-carbon gas fuel based on natural gas, hydrogen, their mixtures, and synthesis gas in power engineering and transport requires detailed information about the kinetics of ignition of these gases at temperatures below 1000 K, at which fuel ignition occurs in internal combustion engines (ICEs) and gas turbines. The same temperature range is also important for monitoring the storage and transportation conditions of these fuels. Although there are quite a few studies addressing the ignition of classical gas fuels such as methane or hydrogen, there is an obvious lack of works dealing with real natural gases and gas mixtures. Furthermore, even for methane and hydrogen, data on the ignition at high temperatures ( $T > 1000$  K), which have been mainly gained by the shock-wave method for highly diluted mixtures, are at variance with the kinetic data for real operation conditions of these gases or their use in ICEs. Considering the ignition characteristics at  $T < 1000$  K is also important for synthesis gas, the largest-scale base product of gas chemistry and the main industrial source of hydrogen. The pronounced discrepancies between the extrapolation of the results obtained for high-temperature ignition to lower temperatures and the results of kinetic modelling of these processes make it necessary to analyze their causes. This review addresses new experimental results on the ignition of methane–alkane and methane–hydrogen mixtures (real gas fuels) and kinetic modelling of these processes, which reveal significant changes in the ignition behaviour at  $T < 1000$  K. These changes in the ignition process upon the variation of the temperature, pressure, and composition of the mixture are related to significant changes in the methane and hydrogen oxidation mechanisms in this temperature range. They are mainly caused by changes in the kinetics and, hence, the role of peroxide compounds and radicals in methane and hydrogen oxidation following temperature and pressure variation. The established features bring about the question of the adequacy of the existing criteria for assessing the knock resistance of gas engine fuels, primarily those containing hydrogen, when they are used in ICEs, and for assessing their explosiveness and measures taken for their safe handling. The review considers the possible methods for improving the detonation characteristics of natural and associated gases to meet the requirements of power equipment manufacturers. Bibliography — 128 references.

## **Nickel is a key element in the future energy**

RCR5086

A.A.Savina, A.O.Boev, E.D.Orlova, A.V.Morozov, A.M.Abakumov

*Skolkovo Institute of Science and Technology, Moscow, Russia*

The review discusses the complex properties of nickel and its role as a critical element for ensuring a confident transition to a new technological paradigm from fossil fuels in favor of using advanced electrochemical storage and energy conversion systems. The main classes of nickel-containing materials of the positive electrode (cathode) for metal-ion batteries are addressed, the place of nickel among other 3*d*-metals used in the industry of electrochemical energy storage is determined. The main methods and approaches to the synthesis of state-of-the-art and next generation cathode materials based on layered Ni-containing oxides are presented. The crystal and electronic structures of these materials, including their evolution in the process of (de)intercalation of alkali metal cations, are considered in the context of their electrochemical properties. The most acute problems facing modern materials science on the way to commercialization and industrial production of new generation high-energy density cathode materials are determined. At the end of the review, promising directions for the further development of nickel-containing cathode materials are outlined.

Bibliography — 252 references.