

# Russian Chemical Reviews

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### Synthesis of $\alpha$ -amino carbonyl compounds: a brief review RCR5046

A.Mukherjee,<sup>a</sup> S.Mahato,<sup>b</sup> D.S.Kopchuk,<sup>a,c</sup> S.Santra,<sup>a</sup> G.V.Zyryanov,<sup>a,c</sup> A.Majee,<sup>b</sup>  
O.N.Chupakhin<sup>a,b</sup>

<sup>a</sup> *Chemical Engineering Institute, Ural Federal University, Ekaterinburg, Russia*

<sup>b</sup> *Department of Chemistry, Visva-Bharati (A Central University), Santiniketan, India*

<sup>c</sup> *I.Ya.Postovskiy Institute of Organic Synthesis, Ural Branch of the Russian Academy of Sciences, Ekaterinburg, Russia*

$\alpha$ -Amino carbonyl compounds are an important class of nitrogen-containing substances. This review highlights their synthesis using various strategies and considers mechanisms of the processes. The strategies are classified into subcategories based on the type of starting materials, chemical reactions and synthetic methods in use. In the literature survey, different types of reactions are discussed like oxidation, reduction, addition, coupling, C–H amination, oxidative cleavage and rearrangement, amidation, multicomponent cascade reaction, *etc.*, for the synthesis of these compounds. Bibliography — 100 references.

### 2D nanocrystals of metal oxides and hydroxides with nanoflake morphology in biomedicine, energy and chemistry RCR5071

V.P.Tolstoy, L.B.Gulina, A.A.Meleshko

*Department of Chemistry, St. Petersburg State University, Russia*

The structural and chemical features of 2D nanomaterials based on crystalline metal oxides and hydroxides with nanoflake morphology, the main methods for their synthesis, and areas of application are considered. Nanocrystals with such a morphology are characterized by an exceptional anisotropy of properties in space, an extremely high proportion of atoms on the surface capable of interacting with the environment, a relatively large number of defects in the structure, and a special electronic subsystem with quantum limitations. Nanoflakes can enter into functionalization reactions with various low molecular weight reagents and form a variety of ‘arrays’. These features are responsible for the unique physicochemical properties of metal oxide and hydroxide nanoflakes and largely determine their practical significance. When considering the issues of preparative chemistry of such nanocrystals, the main attention is paid to methods of synthesis under soft chemistry conditions using solutions of metal salts, in particular, chemical precipitation method, including the use of templates, and successive ionic layers deposition, as well as the processes of interaction on the surface of block metals and at the solution/gas interface. Particular attention is paid to the conditions for the synthesis of nanoflake arrays, *i.e.*, a kind of ‘packing’ of individual particles arranged in an orderly manner on the surface of the substrate and oriented with respect to it. The fields of application of nanoflakes of oxides of metal hydroxides are considered. It is shown that these objects are of significant interest for application in biomedicine, electrochemical energy, chemical sensors, photo- and electrocatalysis, as they are part of various nanomaterials with a unique set of physicochemical properties, including magnetic, electrophysical, electrochemical, optical, sorption and others. Bibliography — 317 references.

### Low-dimensional group IV – VII transition metal polychalcogenides and chemical aspects of their applications RCR5072

E.D.Grayfer,<sup>a,b</sup> S.B.Artemkina,<sup>a</sup> M.N.Ivanova,<sup>a</sup> K.A.Brylev,<sup>a</sup> V.E.Fedorov<sup>a</sup>

<sup>a</sup> *Nikolaev Institute of Inorganic Chemistry, SB RAS, Novosibirsk, Russia*

<sup>b</sup> *Skolkovo Institute of Science and Technology, Moscow, Russia*

This review analyzes literature on polymeric transition metal polychalcogenides of group IV–VII (TiS<sub>3</sub>, VS<sub>4</sub>, NbSe<sub>3</sub>, MoS<sub>x</sub>, ReS<sub>4</sub>, *etc.*). It covers the peculiarities of the structures of crystalline compounds and the proposed structure models of amorphous phases. The latest advances in the synthesis of these low-dimensional materials on the nanoscale are presented. Their chemical properties are discussed, in particular, those associated with their dichalcogenide bonds. It is emphasized that the properties of the S–S (or Se–Se) groups largely determine the distinctive features of polychalcogenides and the unusual phenomena observed in them. Thus, these groups play an important role in the performance of electrode materials in metal-ion batteries, photo- and electrocatalysts for hydrogen evolution reaction, and mercury vapor sorbents based on transition metal polychalcogenides. Bibliography — 304 references.