Lexical and Semantic Features of Nanotechnology Terms

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Abstract. The paper is devoted to the study of lexical and semantic features of terms in the field of nanotechnology e.k. the study of semantic peculiarities of this terminology is one of the poorly studied issues in modern linguistics. The article examines the degree of presence of such semantic processes as polysemy, homonymy, synonymy in the provided terminology. The paper describes the main sources of origin of the above-mentioned semantic processes. It is found that the same lexico-semantic processes and phenomena occur in the sublanguage of nanotechnology as in the general literary language. It is established that such semantic phenomena as intra-system and interdisciplinary homonymy, polysemy, synonymy and antonymy are observed in the terminology under study, and it is proved that ideal terms must have complete semantic neutrality. As a result, the author proves that the nanotechnological terminological vocabulary, in most cases, is neutral and unambiguous, despite the inevitability of the existence of those linguistic processes characteristic of the lexical system of the general literary language. The above phenomena become part of the development of this terminological system. Based on the conducted research, the author suggests the joint work of linguists in the creation of special dictionaries of nanotechnology.

1 Relevance vs. Irrelevance of Semantic Processes for General Terminology

As evidenced by the analysis of special literature on general terminology, at present there is no doubt that the semantic processes of terms, namely polysemy, homonymy, synonymy and antonymy are permissible in terminology. The question of whether the above semantic processes are possible in terminology was the most questionable and debatable in the scientific literature and there was no unambiguous answer to it. One of the poorly studied issues in modern linguistics is the study of the semantic features of nanotechnology terminology, the main sources of origin and the degree of presence of the aforementioned semantic processes in the terminology provided.

In the book V. M. Leichik «Terminology: Subject, methods, structure» it is indicated that at the initial stage the terminology appears - spontaneously accumulate a set of terms inaccurate by semantics and motivation of elements [Leichik, 2007, C. 107]. If inaccurate

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terms appear at the initial stage of terminology formation, then they definitely break up into semantic processes. Thus, the above-mentioned semantic processes are inherent in nanotechnological terminology. According to O. B. Ivanova, "nanotechnological terminology is characterized by an asymmetry of connections between nanotechnological objects, concepts and phenomena, and the terms naming them, as a result of which all these varieties of the absence of a one-to-one correspondence between the signifier and the signified are observed in it" [Ivanova, 2010, p. 12].

The problem of interdisciplinarity is one of the global problems of nanotechnology terms faced by researchers in the organization and standardization of nanotechnology terminology. To create materials with new qualities and unique properties, scientists from different scientific fields were united in working on new technologies for manipulating matter at the atomic and molecular level, which contributed to the emergence of ambiguity in terminology from these different scientific fields.

According to O. B. Ivanova, "nanotechnology provides modern science with huge opportunities to create materials, devices and structures with unique characteristics and, as it develops, arouses interest from medicine, ecology, national defense, electronic and computer technology, aeronautics, etc. These circumstances make nanotechnology a highly multidisciplinary branch of knowledge" [Ivanova, 2010, p. 95].

The development of nanotechnology makes it necessary to apply various interdisciplinary research in such fields as chemistry, biology, physics, computer modeling and their applications, which leads, in particular, to the appearance of ambiguity of the terms used, because in these related sciences, the meaning of numerous borrowed terms often does not coincide. According to S. A. Korolkova and A. A. Novozhilova, "the rather rare use of a term existing in the language with a change in its semantics indicates the need to preserve its unambiguity. And although this technique does not stand out in the traditional theory of translation, in practice it is used, as a rule, in interdisciplinary subject areas" [Korolkova, Novozhilova, 2013, p. 141].

The problem of polysemy occupies a middle position between two opposing views, some scientists resolve the lexical ambiguity of terms, others recognize that terms should be unambiguous "one sign that corresponds to one concept" [Danilenko, 1977, p. 36].

In general, scientists agree that the phenomenon of polysemy is harmful, because it causes complications in communication and violates mutual understanding. [Lotte, 1961, p. 20; Golovin, Kobrin, 1987, P. 48]. In terminology, polysemic relations are widespread, but they are practically implemented in a different way [Superanskaya et al., 2012, p. 44].

2 Semantic processes in terminology of nanotechnology

2.1 Polysemy

Polysemy is quite widely represented in the terminology of nanotechnology. The problem of polysemy is faced in almost all sections of nanotechnology. Often the terms are not translated (for example, into Russian or French), what we discovered in the preparation of a new dictionary of nanotechnology, for example, you can find such terms as, hydrocarbon clusters, daimonoids, multilayer fullerene, hyperfullerene, etc.

S. A. Korolkova, A. A. Novozhilova argue that "the translation of nanotechnology terms is a very serious problem. Violation of the semantic fullness of a word in translation leads to distortion of the meaning of the entire message as a whole and, as a result, to a violation of technology and even legal errors and material damage. Therefore, it is important to determine the main methods of translating terms, which will allow to standardize and unify
the term system of the developing branch of knowledge and human activity" [Korolkova, Novozhilova, 2013, p. 140].

Despite the fact that the terms should have unambiguity within one branch of knowledge, the terms in the field of nanotechnology are ambiguous, for example, the term delamination means: "1) the formation of cracks in multilayer composites at the interface of layers under the influence of external loads; 2) the cleavage of individual layers in layered single-phase materials" [SNT, 2010, P. 343]. The term microweights is used to refer to: "1) a large group of analytical instruments whose mass measurement accuracy ranges from units to hundredths of a microgram; 2) special high-precision instruments that allow measuring the mass of objects up to 0.1 ng (on the scale)" [SNT, 2010, p. 210]. The ambiguity of nanotechnological terms is explained by the fact that in the field of nanotechnology terms were borrowed from such related fields of knowledge as chemistry, biology, physics, for example, the term donor in the field of nanotechnology is "an atom or a molecule that gives an electron or an electron pair to an acceptor" [SNT, 2010, p. 93]. In a broad sense, a donor is an object that gives something to another object, called an acceptor or recipient. In medicine, a donor is a person who gives his blood for transfusion or organs for transplantation to another person called a recipient" [Electronic resource: Goldendict Gnu-Linux Ubuntu version electronic dictionary]. "In physics, a donor is an impurity atom in a semiconductor, the ionization of which leads to the appearance of an electron in the conduction band" [SNT, 2010, p. 93]. "In chemistry, a molecule or particle capable of giving its electron pair to an acceptor and forming a covalent donor—acceptor bond with it" [SNT, 2010, p. 93].

Ideal terms are required to have full semantic neutrality. The first thing that catches the eye when considering some nanotechnology terms is the presence of emotional coloring, for example, the term donor. According to our observations, several terms of nanotechnology are not devoid of emotional coloring. V. I. Litovchenko notes that "ideal terms are difficult to isolate from the linguistic element. Their unambiguity, specialization and emotional neutrality are largely relative. However, the term is thought to be unambiguous and neutral in theory; in living functioning, the term either reveals old (etymological) or develops new (social, emotional) shades" [Litovchenko, 2006, p. 185].

According to some linguists, the sources of polysemy can be the following: 1) polysemy of the corresponding commonly used words; 2) metonymy based on metonymy, i.e. the transfer of the name of one object to another, which is in associative relations with the first one (part — whole, genus — species); 3) author's ambiguity, which means the designation of new concepts and objects by an existing term [Golovin, Kobrin, 1987, pp. 49-51].

O. B. Ivanova points out that "when describing the causes of polysemy in terminology, such an intra-linguistic phenomenon is traditionally noted as the transfer of the name, which can be carried out on the basis of metonymy (designation of the result of the action process through the name of the action, etc.), synecdoche (designation of the greater through the lesser, the genus through the species, the general through the particular and vice versa) and metaphors (based on similarity in shape, color, action, etc.). The analysis of terms from the above-mentioned dictionaries allows us to establish that all these semantic processes are also observed in the terminology of nanotechnology" [Ivanova, 2010, pp. 69-70].

During the study of polysemantic nanotechnological terms, O. B. Ivanova discovered another source of polysemy, which appears "as a result of progress in technical capabilities, the term that originally had the meaning of "abstract mathematical model" develops an additional meaning of "practical implementation of this model"" [Ivanova, 2010, pp. 69-70].

The term channel means: "1) an artificial channel filled with water; 2) a narrow long hollow space inside something; 3) a communication line, communications; a device for
transmitting information" [Electronic resource: Goldendict Gnu-Linux Ubuntu version electronic dictionary]. This term in molecular biology acquires the meaning — "a complexly organized pore in the membranes surrounding cells and intracellular compartments. Channels (pores) perform transport functions when transferring various substances through biological membranes, which are a natural barrier between cells and the environment" [SNT, 2010, p. 117].

Another example is the term quantum dot, which is defined as: 1) "a particle of a material with a size close to the wavelength of an electron in this material (usually 1-10 nm in size), inside which the potential energy of the electron is lower than outside it, thus the movement of the electron is limited in all three dimensions" [SNT, 2010, p. 126]; 2) "an isolated nanoobject, the properties of which differ significantly from the properties of the bulk material"; 3) "this is a fragment of a conductor or semiconductor, limited in all three dimensions and containing conduction electrons" [Electronic resource: Goldendict Gnu-Linux Ubuntu version electronic dictionary]. Due to the development of quantum dot technology and the increasing requirements for creating a "computer of the future based on quantum dots", currently "the term quantum dot has two meanings: 1) a model of a system that localizes an electron in some place in space; 2) a specific device designed to implement a quantum dot" [Ivanova, 2010, p. 72].

According to O. B. Ivanova, "when studying the terminology of the sublanguage of nanotechnology, it is found that the development of polysemy in it occurs through four channels. This is a traditional transfer of the name based on metonymy, synecdoche, metaphor. In addition, the term may acquire new meanings as a result of borrowing terms in a similar meaning from related terminologies. Another specific source of the emergence of ambiguity is the development of the term, which originally had the meaning of "abstract mathematical model", the additional meaning of "practical implementation of this model". It seems that this mechanism of formation of new meanings is specific to terms that came to nanotechnology from quantum physics. And, finally, nanotechnology, which is in statu nascendi, is characterized by linguistic phenomena inherent in all emerging terminologies" [Ivanova, 2010, p. 73].

In the special literature, an extralinguistic reason for ambiguity is noted — the borrowing of terms similar in meaning from related terminologies. The material we have collected shows that this process is observed in nanotechnology terminology, in which terms from different fields of science and technology have been assimilated over time. For example, a primary particle: "1) the smallest identifiable part of a particular system; 2) a solid or liquid particle introduced into the air or formed from steam as a result of nucleation" [PAS 71, 2005, C. 5] [Cit. by: Ivanova, 2010, pp. 13-14]. Another example is the term secondary particle: "1) a particle formed in the gas phase by chemical reactions (conversion of gas into a particle); 2) a particle formed from primary particles as a result of aggregation or agglomeration" [PAS 71, 2005, C. 5] [Cit. by: Ivanova, 2010, pp. 13-14].

### 2.2 Homonymy

In the terminology literature, it is considered that both the phenomena of polysemy and homonymy can be present in terminology. Terms may enter into other terminological systems or become identical in their sound with general literary words. In this case, we are dealing with interdisciplinary (interscientific, intersystem) homonyms [Danilenko, 1977, p. 70] and intersectoral homonyms, which are most common in terminology [Superanskaya, 2012, p. 48].

The transition of borrowed terms in each new branch of knowledge is accompanied by the filling of terms with new content, while acquiring new semantic properties or losing some of the former ones. Usually, this transition occurs to a field close to the subject.
Nevertheless, in the terminology of nanotechnology, a transition of borrowed terms to a rather distant sphere has been found. According to O. B. Ivanova, "the phenomenon of interdisciplinary homonymy is characteristic of the terminology of nanotechnology. Perhaps this phenomenon is particularly pronounced in nanotechnology, in any case, we have not met with a discussion of this phenomenon from other authors whose work is related to the study of other multidisciplinary branches of knowledge, such as ecology, computer science, etc." [Ivanova, 2010, p. 98].

Following O. B. Ivanova, A.V. Razduev emphasizes that homonymy "is represented mainly by its interdisciplinary variant. All the above-mentioned features of the English sublanguage of nanotechnology were taken into account when constructing its lexicographic model" [Razduev, 2013, p. 25].

The main sources of homonyms are: 1) the separation of several meanings of a polysemous word; 2) the change of words that previously sounded differently, their convergence; 3) borrowings from different sources [Superanskaya et al., 2012, p. 45].

We cannot but agree with O. B. Ivanova, who notes that "interdisciplinary homonymy in the sublanguage of nanotechnology is not always removed by context, apparently due to the fact that many of the disciplines involved in nanotechnology are closely related to each other both in the subject of research and in the methods used. This circumstance, apparently, can be considered a specific feature of the sublanguage of nanotechnology" [Ivanova, 2010, p. 8]. For example, the term aggregate has the following meanings: 1) in nanotechnology, an aggregate is "a collection of particles loosely held together" [SNT, 2010, p. 7]; 2) "an aggregate in engineering is an association of several machines, devices or apparatuses into a single whole for working in a complex"; 3) "an aggregate in engineering is a machine unit consisting of individual parts that performs a certain function"; 4) "an aggregate in mineralogy and petrography is an accumulation, coalescence of individual minerals that make up the mining rock, ore and components differing in composition and shape" [Electronic resource: Goldendict Gnu-Linux Ubuntu version electronic dictionary].

Another example is the term sedimentation: 1) in nanotechnology, sedimentation is "the settling of particles of the dispersed phase (solid grains, liquid droplets, gas bubbles) in a liquid or gaseous dispersion medium in a gravitational field or in a field of centrifugal forces" [SNT, 2010, p. 362]; 2) "in chemistry, the settling of small particles of a body in a liquid or gas under the influence of a gravitational field or centrifugal forces"; 3) "in geology — sedimentation" [Electronic resource: Goldendict Gnu-Linux Ubuntu version electronic dictionary].

2.3 Synonymy

The lack of synonymy in a single term system is one of the main requirements that apply to the term. The term cannot have synonyms, because it must relate directly to the concept. The phenomenon of synonymy is more or less characteristic of any terminological system. Nanotechnological terminology is characterized by a wide development of synonymy, however, in this terminology there is a lack of unambiguous correspondence between nanotechnological concepts and the terms naming them, for example, atomic force microscopy, deposition of atomic layers, amphoteric. The number of synonyms in this sublanguage is constantly increasing, which is a characteristic feature of the emerging terminological systems.

V. P. Danilenko points out that the phenomenon of synonymy in scientific terminology characterizes the initial stage of the formation of terminological systems, when the choice of the best term has not yet occurred [Danilenko, 1977, p. 73]. Following V. P. Danilinka, A.V. Razduev notes that "due to the ongoing formation of terminology and the asymmetry
of connections between objects, concepts and phenomena of nanotechnology and the terms naming them, polysemy, homonymy and synonymy are quite widely represented in the sublanguage under consideration. Synonymy is quite widespread (about 25% of the sample of 10200 terms), while terms have several structural or semantic synonyms, usually from one to seven” [Razduev, 2013, p. 24]. For example, quantum bit = qubit = q-bit; nanoengineering = nanotechnology; nanoobject science = nanoscience; mask = template; resistive layer = resist; probe sensor = measuring probe; amphiphilic = diphilic, etc.

B. N. Golovin and R. Y. Kobrin distinguish three types of terminological synonyms: 1) terms-doublets of foreign language origin; 2) terms — syntactic synonyms, i.e. syntactic constructions correlated in structure and coinciding in meaning; 3) definitional synonymy, i.e. coincidence the meaning of the term and its definitions [Golovin, Kobrin, 1987, pp. 54-58].

V. P. Danilenko, in turn, notes that the terminology mainly implements the "semantic variety of synonymy with its characteristic substitution functions": 1) a borrowed term is a Russian term, for example, a resolution — a decision; 2) a full version of the name, a short version of the name, a perforation card — a punch card; 3) a verbal expression of the concept, a symbolic expression of the concept; 4) a terminological combination — an abbreviation, an efficiency coefficient; 5) a family term "a term created by allocation of classifying features of the concept”[Danilenko, 1977, P. 73-79].

D. S. Lotte, S. V. Grinev-Grinevich urge to distinguish between absolute and relative synonyms. Absolute synonyms are synonyms with identical meaning, and relative synonyms are synonyms with similar meaning, i.e. they are characterized by partial coincidence of values [Lotte, 1961, p. 22; Grinev-Grinevich, 2008, p. 105–108].

It should be noted that currently there is no general awareness of the essence of the phenomenon of synonymy in terminology, the terms synonymy and doublet are defined differently. The reason for the confusion of these concepts is the different sources of the formation of terms. In the special literature it was stated that terminological doublet is "words or phrases that are united by a special terminological correlation with the same scientific concept and the object of reality” [Golovin, Kobrin, 1987, p. 54].

Speaking about the synonymic connection in the terminology of nanotechnology, A.V. Razduev writes, "the most frequent are synonymous variants with varying degrees of completeness of components (it is obvious that the full version of the nanotechnology term includes the maximum set of its constituent term elements). A short version is formed as a result of abbreviation and abbreviation (addition of the initial letters or parts of words of a multicomponent term), ellipsis (omission of one or more components of a complex term) or composition (addition of words or bases of a multicomponent term). In the corpus of terminological units under study, the main ways of forming truncated synonymous variants are abbreviation and ellipsis” [Razduev, 2013, p. 25]. For example, micro-optoelectromechanical system = MOEMS; microelectromechanical system = MEMS; atomic force microscope = AFM; diffraction of slow electrons = DME; scanning tunneling microscope = STM, etc.

2.4 Antonymy

V. P. Danilenko notes that "the vocabulary of the language of science is characterized by antonymy not less, but rather more than general literary” [Danilenko, 1977, p. 79]. Lexical and word-formation antonyms are allocated to her. Lexical antonymy can be represented by such examples: north — south, fast — slow, etc. [Ibid., p. 80]. The word—formation antonymy is characteristic of education with the help of affixes: party — anti-party, ideological - unorthodox [Golovin, Kobrin, 1987, p. 59].
Speaking about antonymy in the terminology of the sphere of nanotechnology, A.V. Razduev asserts that "antonymic relations in both sublanguages are mainly based on the opposition of the sizes of objects: micro (nano-) — macro (micro — macro), nanoobject — macroobject (nanoobject — macroobject), nanomaterial — (just) material (nanomaterial — material), nanostructure — macrostructure (nanostructure — macrostructure), etc." [Razduev, 2011, p. 169]. For example, localization dimension — delocalization dimension; top-down technology — bottom-up technology; lyophilic — lyophobic; hydrophilic — hydrophobic, etc.

Analyzing the actual material, we came to the conclusion that most of the antonymic terms in the field of nanotechnology are word-forming antonyms. A.V. Razduev points out that "among the antonymic terms, the most common are structural antonyms, which are formed in the most productive ways for this sublanguage, i.e. prefixed and prefixed suffix, for example: nanoscale — macroscale; nanofilm — macrofilm; nanostructured — macrostructured, microporous — macroporous, etc. The antonymy of most nanotechnological terms is based on the juxtaposition of the sizes of reference objects ("very small — large", "micro, nano — macro")" [Razduev, 2013, p. 25].

3 Conclusion

From all of the above, it can be stated that the semantics of nanotechnological terms are influenced by such linguistic and extralinguistic factors as the emergence of new concepts in terminology, a change in the perception of any concept, the formation of new directions in nanotechnology and the increasing interest of the media in nanotechnology.

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