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Anthropocentric features of the scientific-technical term formation (case study of nanotechnology terms)

Características antropocéntricas de la formación de términos científico-técnicos (estudio de casos de términos de nanotecnología)

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Contents

ABSTRACT:

The paper is devoted to the study of the phenomenon of anthropocentric influence on the process of the scientific-technical term formation drawing on the example of terminological units in the sphere of nanotechnology as one of the priority directions of the development of contemporary science and technology all over the world. The research is focused on the peculiarities of nomination of scientific-technical (nanotechnology) objects, processes and phenomena via terms as a significant part of special lexis. Special attention is paid to the main, salient features that seemed to be important when a scientific-technical term was coined. These features determine the nomination process in the field of knowledge in question. The author points out some anthropocentric features of the English-language nanotechnology term formation placing emphasis on the changes in the structure and semantics of terminological units and their elements. The fact is proved that nanotechnology terminology takes an important place among other actively

RESUMEN:

El trabajo está dedicado al estudio del fenómeno de la influencia antropocéntrica en el proceso de formación de términos científico-técnicos basándose en el ejemplo de unidades terminológicas en el ámbito de la nanotecnología como una de las direcciones prioritarias del desarrollo de la ciencia y la tecnología contemporáneas. La investigación se centra en las peculiaridades de la designación de objetos, procesos y fenómenos científico-técnicos (nanotecnología) a través de términos como una parte significativa del léxico especial. Se presta especial atención a las principales características destacadas que parecían ser importantes cuando se acuñaba un término científico-técnico. Estas características determinan el proceso de nominación en el campo del conocimiento en cuestión. El autor señala algunas características antropocéntricas de la formación de términos de nanotecnología en inglés, haciendo hincapié en los cambios en la estructura y la semántica de las unidades terminológicas y sus elementos. El hecho es demostrado que la terminología de

developing scientific-technical terminologies and is characterized by openness, relatively youth age, ongoing formation and anthropocentrism.
Keywords: scientific-technical term, nanotechnology, anthropocentrism, terminology, term formation, salient feature, structure, semantics

nanotecnología ocupa un lugar importante entre otras terminologías científico-técnicas en desarrollo activo y se caracteriza por la apertura, la edad relativamente joven, la formación continua y el antropocentrismo.
Palabras clave: término científico-técnico, nanotecnología, antropocentrismo, terminología, formación de términos, característica saliente, estructura, semántica

1. Introduction

Cognitive linguistics is one of the newest and rapidly developing directions of contemporary linguistics which is aimed at studying the mechanisms of human mental activity, in particular, the specificity of processes of obtaining, processing, storing and transferring of knowledge. Cognitive linguistics considers the language from another angle, studies it in different interpretations and correlations with the man, human thought and intellect. At present, this science is almost entirely based on the "human factor", anthropocentric approach, on the switching of the researchers' interests from the object to the subject of cognition, i.e., on the analysis of the principle of "man in the language" (Benveniste 1974; Serebrennikov 1988) and language functions in relation to the man. Today, the transition is obvious from the "theoretic study of language elements by means of their inventory and classification to the study of language phenomena from the point of view of anthropocentrism" (Sorokina 2007: 4). At the end of the XXth century we have witnessed "an anthropocentric shift" in linguistics (Vorozhbitova 2003: 43). Anthropocentrism implies placing the man as a perceiving subject in the center of the world map, and the latter is verbalized by different types of lexis and texts. Scientific-technical sphere is characterized by the presence of special scientific world map reflecting special objects, processes and phenomena which are nominated by the man with the help of scientific-technical terms. Terminology of a certain field of knowledge is an indicator of its evolution, origin and development of the corresponding scientific knowledge. The scientific-technical terms systematized within the framework of terminological systems can show a contemporary level of scientific knowledge and technical development. One of such scientific-technical spheres is nanotechnology. It is a rapidly developing science, a branch of technology that deals with the dimensions at the nanoscale, especially the manipulation of individual atoms and molecules (Bhushan 2010). Nanotechnology is marked by special, still forming, terminology which has certain anthropocentric features, which are the object of the research.

2. Method

In the study the focus is on the English-language nanotechnology terminology as one of young developing scientific-technical terminologies (see Latu 2015 c). Methodology of the research includes a combination of general and special scientific search methods, collection and processing of linguistic data. General scientific methods embrace the principles of development, determinism, systemacy, interdisciplinarity, anthropocentrism which form the methodological basis of contemporary terminology studies. A set of special scientific methods is used, such as the method of random selection of terms, methods of contextual, distributional and content-analysis, method of reconstruction of term formation models, methods of component, etymological and definitional analysis and cogniolinguistic modelling. The methods of quantitative, qualitative and statistical analysis aimed at the verification of the data obtained, are not less important for the research. About 10,000 nanotechnology terminological units in the contemporary English language have served as the material for the research. These terms have been selected from specialized sources including text and electronic terminological dictionaries, scientific works (books, articles, etc.) and specialized Internet sites devoted to the development and production of nanomaterials and nanostructures, machinery for nanosynthesis, etc.

3. Results and discussion

Scientific-technical sphere is of special interest for scientists belonging to different fields of knowledge due to its objective character, exactness, urgency, importance for people and the society we live in, significance for future generations, etc. Among other scientists, linguists study special scientific-technical lexis, its semantic and word-formative (morphological, morphological-syntactic and syntactic) peculiarities, as well as ways of its normalization and standardization.

Nowadays nanotechnology (sometimes shortened to "nanotech") is one of the most popular and innovative scientific-technical spheres all over the world. Nanotechnology is an open and relatively new field of knowledge that has been formed on the basis of other science fields, such as biology, chemistry, physics, material science, and engineering. Nanotechnology studies objects, phenomena and processes conducted at the nanoscale (from 1 to 100 nanometers) (Bhushan 2010). Nanotechnology comprises some peculiarities of both fundamental and applied science and technology, reflects the latest achievements of other sciences. Nanotechnology is the way discoveries made at the nanoscale are put to work. This science deals with the theoretical foundations, practical methods of research, analysis and synthesis, as well as the methods of production and application of products with a certain atomic-molecular structure by means of controlled manipulation of individual atoms, molecules, and nanoparticles in a useful way. Nanotechnology is characterized by special young age and forming terminology. During its formation, this terminology obtains certain anthropocentric features, which have not yet been studied from a linguistic perspective. The English-language nanotechnology terminology has been chosen as the material for the research due to the fact that it is the contemporary English language where this terminology appears, develops and is borrowed in one form or another by other languages.

Today, many linguists are the advocates of the anthropocentric approach to the study of language and linguistic phenomena, and this approach supposes the comprehension of language in a close contact with the man (Boldyrev 2015 a; Boldyrev 2015 b). Nanotechnology as a scientific-technical sphere and corresponding special lexis are not an exception. In particular, in the framework of scientific-technical activity the man (the subject) becomes an active participant of various nominative processes: primary (naming, nomination proper) and secondary (renaming, rethinking and naming) nomination (Gak 1977; Gak 1998; Serebrennikov 1977; Teliya 1977; Ufimtseva 1977; Kubryakova 1986; Latu 2015 b, etc.). The subject is the source of formation of different nominative units based on common and special types of lexis, and all the models of term derivation (morphological, morphological-syntactic and syntactic ones (Grinyov-Grinevich 2008)) are anthropocentric *per se*. A terminological unit (especially, a scientific-technical term) is often formed on the basis of the subject's knowledge and as a result of the subject's actions (including the knowledge of collective subjects, such as a group of scientists). It functions for a period of time in speech and written texts in the framework of scientific-professional communication, gets its definition and widespread use in the scientific-technical sphere, obtains scientific recognition in one or several countries, and is fixed in glossaries and other types of dictionaries, terminology standards, etc.

Anthropocentrism in the scientific-technical terminology is shown both implicitly and explicitly, and mainly its features are hidden in the underlying form of the term (see Latu, Razduev, Monogarova 2016; Latu 2015 a). First of all, anthropocentrism is reflected in the choice of **the length of terminological units**. In terms of one- or multicomponent scientific-technical terminological units, the chicken or the egg causality dilemma is not relevant: one-component terms, terminological units with lesser number of components (terminological elements) appear in general before multicomponent terms, terms with greater number of components. Multicomponent terms are built on the basis of simple (one-component) terms. One-component terms are used for the designation of new scientific-technical (nanotechnology) notions, as well as generic / superordinate notions (for example, *synthesis*), while multicomponent ones are

employed for the verbalization of subordinate notions, already known, existing and developing in the sphere of nanotechnology (*gas-phase synthesis with vapour condensation*).

The formation of multicomponent terms is conditioned by the aspiration of the subject as a source of nominative activity for reflecting as many as possible objective main, salient features of the notion (Alimuradov, Latu 2008; Croft, Cruse 2004; Jackman 1996; Johnson-Laird 1983, etc.), revealing its essence, and at the same time the choice of corresponding terminological elements (lexical means) and their quantity necessary for a certain interpretation of the scientific-technical notion is subjective and individual, it is based on the preferences of the subject – the author of the term, when he or she chooses a lexical unit from a set of possible variants, synonymic rows, etc., use this or that common language or special word-formative model. For example, a group of ions can be called *a cluster, a group of ions* (**N+Prep.+N**) or *an ionic group* (**Adj.+N**), and only the last two terms underline the feature of the "composition of ions" (not atoms, molecules or other particles), that is implied in the term *cluster* and is brought out of its definition: *a compact isolated group of interconnected atoms, molecules and **ions**, which has special features, to a certain extent different from the features of its components* [http://thesaurus.rusnano.com/wiki/article947].

The choice of necessary terminological elements and their quantity, word-formative model is subjective and individual, it is based on the preferences of the subject (even collective) as the author(s) of a term, on knowledge and experience, including the language one, on the experience of other scientists and other scientific-technical spheres.

There are two opposite tendencies in the English-language nanotechnology terminology. On the one hand, the subject forms a multicomponent scientific-technical term and, on the other, tries to reduce its length, to exclude less semantically significant components, in particular, with the aim of economy of language / speech means while keeping the notion (ellipsis, blending, compounding, abridgement, abbreviation): *multi walled (carbon) nanotube, nanobionics (nano- + bio- + electronics), nanotech (nanotechnology), molmac (molecular machine), SWCNT (Single-Walled Carbon Nanotube), laser (light amplification by stimulated emission of radiation),* etc.

Nomination in the scientific-technical sphere implies **the choice of a primary** (in many cases – main, salient) **feature** it is based on, according to which the formation and development of the meaning of the term is occurring.

From the viewpoint of anthropocentrism, important salient features in the English-language nanotechnology terminology on which terminological nomination is based include: *size / scale* (about 43.5% of the corpus of selected nanotechnology terms; **micro***hardness*, **nano***technology*, **microscale** / **nano-scale** *friction*, **micromolecule**, **atomic-scale** *addressing*); *material* (about 9.5% of terms; **inorganic / organic** *nanoparticle*, **carbon** *nanotube*, **carbon** *nano***material**, *nano***fiberglass**); *peculiarities of application / functioning* (about 5.5% of terms; **cryochemical** *synthesis*, **chemical** *nanomaterial*, **biological** *nanomaterial*, **electrochemical** *supercapacitor*, **multifunctional** *nanoparticle*); *special physical characteristics* (about 5.3% of terms; **magnetic** *nanoparticle*, **magnetic** *nano***fluid**, **ferromagnetic** *nanomaterial*); *aggregate state* (about 5.1% of terms; **gas-phase** *nanotechnological process*, *chemical* **vapour** *deposition*, **liquid-phase** *epitaxy*); *space / locus* (about 3.5% of terms; **extracellular / intracellular** *matrix*, **intramolecular** *interaction*, **field** *ion microscope*, *lab*-**on-a-chip**); *light* (about 3,3% of terms; *dynamic* **light** *scattering*, **fluorescent** *nanoparticle*, *atomic* **fluorescence** *analysis*); *form / structure* (about 3.1% of terms; **continuous / short** *nanofibers*, **straight** *nanotube*, **curved** *nanotube*, **Y-junction** *carbon nanotube*); *quantity / intensity* (about 2.2% of terms; **low-energy / high-energy** *electron microscopy*, **high-energy / low-energy** *electron diffraction*, **high performance** *liquid chromatography*); *weight / mass* (about 2% of terms; **light** *molecule*, **medium** *molecule*, **heavy** *molecule*); *temperature* (about 2% of terms; **freeze** *drying*, **hot / cold** *atom*, *low temperature sintering*); *colour* (about 2% of terms; **blue** *shift*, **grey** *goo*, **pink** *goo*, **white** *emitter*), etc. (Novichkov 2009; http://thesaurus.rusnano.com, http://nanodic.com), etc.

It should be noted that in case of the terms with two or more components several salient features can be used at the same time, for example, *nuclear magnetic resonance* (*nuclear* – "*size / scale*", *magnetic* – "*special physical characteristics*"), *carbon nanotube* (*carbon* – "*material*", *nano-* – "*size / scale*", *tube* – "*form / structure*"), *nanoporous material* (*nano-* – "*size / scale*", *porous* – "*special physical characteristics*", *material* – "*material*"), etc.

In the process of term formation, the subject can use **a direct indication of a linguistic personality of the scientist:** a name or a surname of the scientist (proper name) that is used as a terminological element. On the one hand, these are features of anthropocentrism (and even egocentrism), when a scientist gives the name to a created nanotechnology object, discovered process or phenomenon. On the other hand, the subject tries to immortalize the other scientist's name, to express recognition among scientists, to show a profound respect for them on the part of other scientists. Due to its specificity, the salient feature of "*proper name*" is classified as a separate group of features (about 4.5% of the corpus of selected terms). These are examples of eponymic nomination (Nprop.(-Nprop.+N(+N))): *Abrikosov vortex, Auger electron spectroscopy, van der Waals interaction, Miller indices, Stranski-Krastanov growth mode, Frank-van der Merve growth mode, Ehrlich-Schwoebel barrier, Schwoebel barrier, Rayleigh scattering, Fresnel lens, Hall-Petch relationship, Josephson effect, Krafft temperature, Langmuir-Blodgett method, Lennard-Jones potential, Mössbauer effect*, etc. It is obvious that the subject can use both appellative lexis and proper names in the nomination process. Sometimes they face a choice between the eponymic term and its synonym without a proper name, for example, *Vollmer-Weber growth mode – island growth mode*.

In the process of scientific-technical term formation the subject (specialist) less frequently expresses his or her **attitude, subjective evaluation** on the basis of personal experience, perception, feelings and sensations, and the corresponding terminological unit gets a positive or negative connotation, emotional-evaluative colouring (about 3.5% of the corpus of selected terms). For example, **abnormal** *wear,* **abnormal** *wear particle,* **abnormal** *grain growth,* **critical** *size of island,* **critical** *micelle concentration,* **critical** *concentration of coagulation,* **giant** *magnetoresistance,* **great** *blue-shift,* **normal** *grain growth,* **normal** *qubit,* **normal** *core,* **supra**molecule, **super**foam, **super**conducting core, etc.

The choice between terminological elements during the construction of a nanotechnology multicomponent term in a written text or speech is also conditioned by its **context**. Classifying and main terminological elements (Latu 2015 b) can be borrowed both from everyday communication (common words, for example, *nanoscale* **object**, *Raman* **effect**, **surface** *diffusion*) and special spheres (special lexis, for example, *nano***reactor**, *nano***whisker**, *super***capacitor**). Due to the specificity of texts and communication in the sphere of nanotechnology, designations of special objects, processes and phenomena prevail. Moreover, the choice of terms and terminological elements by the subject is also conditioned by their collocation with both common and special lexis.

On the one hand, in terms of anthropocentric term formation, a very important point is **the construction of synonymic rows of terms** by the subject (that is characteristic for young age, forming terminologies, such as nanotechnology terminology), when one nanotechnology notion has several verbalizators in the language which are semantically close, for instance: *nanomachine, nanorobot, nanobot, nanoid, nanite, nanomite*, etc. Then terminology is ordered, unified and standardized, and in the end only one term verbalizes the corresponding notion. On the other hand, **the creation of explicit and implicit semantic oppositions** is also important for the term formation process (see Alimuradov, Latu 2010), when the subject opposes the meaning of one term to the semantics of another, forms a new special unit on the basis of opposition to the already existing one, thus, contributing to the development of scientific knowledge. The implicit semantic opposition (the case of a terminological lacuna, when an opposite term does not exist) is often replaced by the explicit one after a while. For example, **carbon** *nanotube* – **non-carbon** *nanotube,* **short** *nanotube* – **long** *nanotube,* **hot** *atom* – **cold** *atom,* **high-energy** *ball milling* – **low-energy** *ball milling*, etc.

Anthropocentrism in the term formation process is shown in the implementation of the transfer of meaning – **metaphorization** and **metonymization** (metaphtonymization), when the subject uses certain characteristic, familiar images of the naïve world map for reconsideration, applies some names of usual, everyday and frequently used objects, processes and phenomena in the course of term formation in relation to similar objects, processes and phenomena in a special sphere owing to their similarity, likeness, resemblance of their features and characteristics (Boldyrev 2014; Budayev, Chudinov 2008; Lakoff, Johnson 2003; Punter 2007; Searle 1979, etc.). In this case we deal with the secondary nomination process.

Metaphor is quite often regarded as a universal cognitive mechanism, when one field of human knowledge (including everyday life) is considered in the light of another one on the basis of analogy or similarity. Secondary nomination does not only reflect human knowledge about the world, but also forms different types of attitude of the subject to the fragments of this world (evaluation). One can distinguish the anthropomorphic type of metaphor due to the fact that it is characteristic for humans to learn the laws of nature through their personal biological and social experience (see Lyaschenko 2015). In case of secondary nomination, the selection of a nanotechnology term or terminological element in a written text or speech is conditioned by its metaphorical and/or metonymical (metaphtonymical) context. This context is understood as a specific metaphorical and/or metonymical use of a word, certain realization of a figurative meaning of a lexeme (a term), transfer of its meaning by similarity and/or contiguity in a phrase or sentence, which is sufficient for its interpretation. In case of semantic terminological derivation, the subject uses main, salient features of the notion which are peculiar to human beings, for example, intellect, intelligence, quick-wittedness, and transposes them to an inanimate object or objects: **smart** *dust,* **smart** *material,* **smart** *actuator,* **smart** *yarn,* **intelligent** *bionanomaterial,* **intelligent** *nanodevice,* **intelligent** *dust particles, arti***lect** *(artificial* **intellect***)* [http://thesaurus.rusnano.com; http://nanodic.com, etc.]. "Smart" materials are capable of relatively complex behaviour due to the application of nanocomputers and nanomachines, for example, special features, response to the requests or changes of the environment. It should be noted that the image / feature "smart" is important and necessary for the subject, and the corresponding term (terminological element) has a positive connotation. Nowadays, there is an opposite term with a negative connotation that emphasizes the opposite features: *non-smart materials.* As it has been mentioned above, the subject can use certain lexical units from common lexis, the names of surrounding artefacts while naming special objects, processes or phenomena: *nano***sandwich***, nanotube* **cap***, nano***pillar***, nano***ink***, nano***powder***, nano***wire***, nano***ribbon***, nano***belt***, nano***pores***,* etc.

Moreover, the term formation process in the sphere of nanotechnology follows the path of metaphtonymization, i.e., besides metaphorization the subject uses the metonymical model "Part-Whole", when the name of a part of an object is used instead of the name of a whole object: *electronic nose (e-nose), electronic tongue (e-tongue), electronic skin (e-skin),* etc.

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4. Conclusion

Anthropocentric component is obligatory for the scientific-technical term formation process. The sphere of nanotechnology as one of the priority directions of the development of contemporary science and technology around the world and its terminology is not an exception. This terminology takes an important place among actively developing scientific-technical terminologies, it is open, relatively young and forming. The English-language nanotechnology terminology that verbalizes scientific-technical (nanotechnology) objects, processes and phenomena has certain anthropocentric features which are shown both explicitly and implicitly.

The man as the subject of all nominative processes is the most important element of anthropocentric term formation: the subject gives the initial name to a nanotechnology object, process or phenomenon and/or gives the denomination based on reconsideration (change of meaning). The formation of one-component terms is primary in general, and the construction of multicomponent terms is conditioned by the desire of the subject to reflect to the maximum

certain objective and subjective main, salient features of the scientific-technical notion, to reveal the essence of the latter. Owing to the use of main, salient features one can distinguish one notion from another. The characteristic "*size / scale*" is the most frequently used salient feature in the sphere of nanotechnology in the modern English language. Other salient features which are important for the man as the source of nominative activity and a participant of the communicative activity include: "*material*", "*peculiarities of application / functioning*", "*special physical characteristics*", "*aggregate state*", "*space / locus*", "*light*", "*colour*", "*form / structure*", etc. In the course of time multicomponent terminological units can be abridged / abbreviated in different ways following the principle of language or speech economy. The choice between terms in the process of terminological nomination can be conditioned by the context. The construction of synonymic rows, as well as explicit and implicit semantic oppositions by the subject is also important in terms of the anthropocentric term formation. Besides, in the process of constructing terminological units the subject (specialist) can more or less explicitly express his or her subjective opinion, viewpoint, evaluation (positive or negative) about an object, process or phenomenon in the sphere of nanotechnology. Eponymic nomination presupposes a direct indication of the scientist as a linguistic personality. Secondary nomination is not less significant; it is based on the reconsideration of the existing lexical units of common and special types of lexis (in particular, terms) on the basis of the transfer of meaning by similarity (metaphor) and contiguity (metonymy). In some cases, the subject uses metaphorization and metonymization in combination (metaphtonymization).

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