

**Didenko<sup>1</sup>, Yu.V., Radchenko<sup>2</sup>, A.I., and Koval<sup>3</sup>, N.V.**

<sup>1</sup> Scientific Publishing Council, the NAS of Ukraine, 54, Volodymyrska Str., Kyiv-30, 01601, Ukraine

<sup>2</sup> PH «Akadempriodyka», the NAS of Ukraine, 4, Tereshchenkivska Str., Kyiv-4, 01004, Ukraine

<sup>3</sup> Sector of Social Sciences, Presidium of the NAS of Ukraine, 54, Volodymyrska Str., Kyiv-30, 01601, Ukraine

## INFORMATION SYSTEM WEB OF SCIENCES: MIRROR OR TOOL?



*The degree of presence and «visibility» of scientific articles of Ukrainian scientists in the database Web of Sciences Core Collection is briefly described. Survey is conducted for the category «scientific article» in the category «Ukraine». The focus is on the 1991–2016 period. The main causes of low «visibility» of national publications in this database are determined. Initial steps to address the problems are proposed.*

*Keywords: scientific article, scientific publication, citation index, National Academy of Sciences of Ukraine, Web of Sciences Core Collection.*

During the last decade, the progress of database and computerization of almost all social institutions and processes have led to the formation of network technologies which allowed us to handle the enormous amount of information. An example of such network technology is Web of Knowledge information platform, one part of which is the Web of Sciences information platform (WoS). The WoS is the largest continuously updated database of citations which now includes more than 60 million records of publications from nearly 13 thousand scientific journals. Note, that most of the comparative assessments of the national science contribution to the world science and rating of scientific research and educational institutions are based on the WoS bibliometric indicators. Monitoring of these bibliometric indicators is performed in all advanced countries. The data of research productivity helped to make the strategic decisions on the important areas of scientific research development, to assess the positions of scientific institutions or uni-

versity in relation to the international standards in a particular field of knowledge.

The publication activity of the Ukrainian scientists looks rather low when taking into account only the information available in Scopus and WoS; every scientist in Ukraine publishes articles 10 times less than, in average, in the developed countries. About 12 percent of all scientific works of the Ukrainian scientists are published in the best international journals (30 percent in the EU; 40 percent in the USA). These are basically the articles published in collaboration with the foreign partners. This collaboration can be described, for example, using the following indicators: of more than 7.2 thousand articles of the Ukrainian scientists presented in the Scopus and WoS databases in 2003, as well as of more than 10,000 publications in 2013, in collaboration with the foreign colleagues, only a half of them were published [1]. And this despite the fact that in 2013, the scientists of the NAS of Ukraine published 27.3 thousand of scholarly articles, including 6 thousand published abroad [2].

However, analyzing these figures it is necessary to bear in mind that the implementation of schol-

arly research involves the publication of their results. Costs for their publication are laid down in the research grants. So, a scientist who performs research can choose, in his opinion, according to the requirements and rating in a particular industry any the most suitable journal for publishing his achievements and pay for this publication at the expense of grant funds. The WoS analytical tools allow you to relatively easy make the choice of publishing office for the future publications: they allow you to choose by the keywords the necessary editions, to get acquainted with the citation level of their publication, as well as with the requirements of these publishing offices for publications, release date, the terms of review and payment, etc. This is exactly what allows you to speak about the mandatory open access to the results of scientific research, since the work of journals and publishers is paid by the scientists. The most recent example is the recommendations for the participants of Horizon – 2020 program [3] which require all research content obtained within the funds of this program to be released to the public.

However, the national legislation does not provide for the official payment of publications in the national and especially in the foreign editions published at the cost of scientific topics, programs and grants. This deprives the Ukrainian scientists and the Ukrainian science, in general, the possibility of proper representation in the global information space. Under these conditions, an important step would be the introduction of mechanisms to encourage the Ukrainian scientists through providing funds to pay publications in the top-rated editions. This will lead to increasing the number of not only Ukrainian publications in collaboration, but also of individual publications in the scientometric databases and to desired growth of citation indicators.

One can obtain a great amount of the WoS information by performing the searches on the thematic grounds, by categories of search, by which all publications are grouped by keywords. However, the national scientists chose the keywords for publication using the traditional (to a great

extent the Soviet) formulation of scientific fields and passports of specialties; therefore, the search by categories or search complicated by interpretation gives sometimes the unexpected results. Passports of specialties that meet the WoS search categories were approved in Ukraine, last year.

So, what can we see today in the WoS making searches by country, name of scientific and educational institutions or thematic areas? Do the results reflect the real situation? What needs to be done to precisely determine by means of the obtained results the place of the Ukrainian science and role of the national scientists in the world?

Memorandum of Understanding signed on September 27, 2016, between the National Academy of Sciences of Ukraine and *Thomson Reuters*, in particular, noted that the parties agreed to study the feasibility of using by the NAS of Ukraine and its institutions of solutions with respect to the analysis of the work efficiency and development of international cooperation based on tools of In-Cites, WoS, Thomson Innovation resources.

Initially, we should investigate and fix a state of representation of the Ukrainian publications, in general, and publications of the NAS of Ukraine, in particular, in this database. Further access to these resources will give points to the ways of improving the «visibility» of our scientific results and help to more clearly formulate the task of improving the efficiency of publication and ways of their solutions.

What does the base consist of and what can be found there? The main source of information for the database content is the scientific journals from different disciplines. So, the database contains information about all the publications contained in the original releases of indexed journals. It should be emphasized that the database does not contain the full texts of publications, it is only an aggregator of abstract information, the so-called metadata to the original articles. However, the metadata always includes the information about where and under what conditions a particular paper may be available for the review in full. The abstract information includes the following:

- ✦ Bibliographic data: name of the author (s), title, name of article, name of the journal in which the article was published, year, volume, number, pages;
- ✦ Structural abstract provided by the author (s); the base does not contain an abstract, it shows only the information available in the journal;
- ✦ Keywords are usually provided not only by the author of the original text of the publication, but also those defined by the system at the date of publication receipt, based on the automated algorithms and internal thesaurus of keywords;
- ✦ Theme (thematic section, category) of article according to one or more topical subjects, often all publications of a journal have one thematic category (or categories);
- ✦ Specified publication type (article, review, conference report, section of the book, etc.);
- ✦ Information about the organization in which the author works;
- ✦ Information about the organization or organizations engaged in the research funding (name of organization (s) and grant number);
- ✦ Title of ISSN magazine;
- ✦ Information on the original language of publication;
- ✦ Information on the Publisher
- ✦ List of citations to each article.

In addition to the scientific journals, the WoS is engaged in processing of the conference proceedings (describes the full-text reports), books (accordingly, sections and chapters description), as well as patents.

Very important is the «List of Citations» field. Today, the prevailing trend is the increase in the lists of citations and introduction in them as much as possible scientific articles published recently (during the last five years and depending on the scientific field) and already included in the scientometric databases or available in the open access on the resources of rated publishers and organizations. Thus, this field is a key one for the bibliometric databases: it is precisely that information which makes the database bibliometric. Each analytical system that includes data on citations is based on the

collection and processing of information which is received only from the sources that refer to a particular system. The initial measurement unit is a unit of publication (article, review, letter, report, book chapter) with respect to which you can calculate the number of its citations from the above reference list and the number of citations of this publication [4]. Therefore, the scientometric bases making the selection process of new publications, consider a reference list in the Roman alphabet, according to the international bibliographic standards, to be a necessary requirement.

Each field of metadata articles is simultaneously a search criterion for the database work.

In September this year, the employees of scientific and methodological support group of the NAS of Ukraine publishing activities have been granted a trial access to the Web of Sciences Core Collection (WoS CC). Unfortunately, we have no access to other resources and tools that provide a means for more detailed and accurate research, but, nevertheless, we have tried to get the maximum amount of information.

To analyze the publication activity of the Ukrainian scientists in this study we selected a core of the WoS CC international system scientific citations that offers a comprehensive range of analytical indicators and the analysis tools that can indirectly characterize a quality of scientific publications. The base system can work with the filters through which you can search for and sort the materials by years, publications, countries, thematic areas, keywords and institutions where the authors work and institutions that provide funding to perform research, author's name, etc. As a result of sampling filters one can receive information on the number of publications and a list of them, the number of citations made to these publications, and a record about who and where made a fixed citation.

The WoS is an information platform (or multidisciplinary database) that consists of specialized databases containing the various types of documents in different sections of science. There are three databases formed from the materials of perio-

dicals: Science Citation Index Expanded (SCIE – natural, technical, engineering, biological and medical, agricultural science); Social Sciences Citation Index (SSCI – Social Sciences), Arts & Humanities Citation Index (AHCI – Humanities and art). Conference proceedings make up two databases: Conference Proceedings Citation Index – Science Edition (natural sciences, engineering sciences); Social Science & Humanities (Social Sciences and Humanities). Books represent two databases: Book Citation Index – Science Edition (natural sciences, engineering sciences); Social Science & Humanities (Social Sciences and Humanities). All publications included in the WoS CC are indexed; citation indexes are calculated for them.

Depending on the choice of the WoS CC citation indices and types of documents to be analyzed the publication activity can be assessed, at least, in three ways:

- ✦ take account of the first three WoS CC blocks only and the types of documents «scientific paper (article)»;
- ✦ take account of the first five WoS CC blocks and the types of documents «scholarly paper (article)», «review», «conference report (proceedings)».
- ✦ take account of all WoS CC blocks and all types of documents.

For consideration, we chose only the type of document «scientific paper».

In total, in the WoS CC (in the above seven blocks) on request «Ukraine» one can find about 190 thousand publications made public from 1900 to 2016, including almost 145 thousand from 1991 to 2016.

An array of the Ukrainian scientific articles in the WoS CC for the period from 1900 to 2016 formed using the filter by the name of the country (Ukraine) totaled nearly 165 thousand entries (individual research papers), including nearly 123 thousand for the period from 1991 to 2016.

Within this sample there are the key directions of the Ukrainian science by a number of publications: material research, physics of condensed

matter, physics, electronic engineering, physical chemistry and at the end of the list comprising almost 200 thematic areas there are psychology, psychoanalysis, music and medical ethics.

The WoS CC includes more than 98 thousand publications for the period of 2011–2015 by the general direction «Physics», of which Ukraine, where Physics is a leading scientific field, accounts for 1 percent and stands 32d on the list of countries. Moreover, for this period 31.5 thousand citations were made to 6.2 thousand articles from different areas of physics associated with Ukraine (excluding self-citations), but eight of the top ten articles were written by the Ukrainian authors as part of scientific collaboration performing research on the Hadron Collider.

According to the report «Revolutionary, Fundamental Innovation, State of Innovation in 2016» [5], the main areas in which one can observe an increase in the innovative activity are as follows: «food, drinks and tobacco», «aerospace and defense industry», as well as «household appliances» the performance indicators of which more than doubled during seven years. By directions «defense industry» and «household appliances» for the period of 2011–2015 Ukraine had no articles in the WoS CC; by «aerospace research» eight publications in Ukraine for the same period which accounted for 0.1 percent of the total amount in the world.

Identification of organizations and authors was one of the most complex processes in our study.

For indexation of scholarly articles and other publications in the scientometric systems the affiliation is very important (affiliation, organization and its location). A true statement of the author's place of work can correctly identify him and exclude a chance of losing publication indicators of separate authors who have a common name, as well as citation indices of the institutions where they are affiliated. Success of the author (primarily, citing to the author's articles) determines the success of organization where he works. [6] Affiliation in articles should be presented so that it can be easily and accurately identified and pro-

cessed by the automated means, like all other metadata of article. It is important that the WoS CC beginning from 2008 provides an opportunity of enhanced affiliation. This means that a scientist can specify in the article more than one job. For example, place of work by the research grants and a principal place of work.

Since the base allows you to search by name of institution, then it is very important for researchers to observe in all articles the following recommendations:

- ✦ to follow a unified name of organization, as a rule, recorded in the charter of the organization and presented on its official website; if administration does not require its authors a uniform spelling of organization name in the articles and does not offer the alternative views, there appear inevitable errors in spelling and recognition which result in the loss of data;
- ✦ to write in English a full basic name of organization without abbreviations and acronyms; abbreviation can be given in brackets after the full name;
- ✦ affiliation should be complete by a geographic principle, except for the name of the organization, and should contain the location data (at least, the name of the city and country).

Example of correct affiliation:

M. M. Bogolyubov Institute for Theoretical Physics, National Academy of Sciences of Ukraine, Kiev, 03680, Ukraine

or

M. M. Bogolyubov Institute for Theoretical Physics, National Academy of Sciences of Ukraine, 14–b, Metrolohichna str., Kiev, 03680, Ukraine.

Sampling by name of the National Academy of Sciences of Ukraine does not allow receiving the correct results, because the WoS CC affiliation has the following options:

1. Academy of Sciences of Ukraine;
2. National Academy of Science of Ukraine;
3. National Academy of Sciences of Ukraine;
4. National Academy of Sciences;
5. National Academy of Sciences Ukraine;
6. National Academy of Ukraine;

7. Ukrainian National Academy of Sciences;
8. National Academy of Sciences of Ukraine as of Ukraine;
9. NAN of Ukraine;
10. NANU;
11. NAS Ukraine;
12. NAS of Ukraine;
13. NASU;
14. Ukrainian National Academy of Sciences;
15. Presidium of the National Academy of Sciences of Ukraine;
16. Presidium of NAS of Ukraine;
17. Ukraine Academy of Sciences;
18. Ukrainian Academy of Sciences;
19. Ukrainian National Academy of Science;
20. Ukraine NAS.

Each of these records, each affiliation is a separate profile on which the calculation of indicators of publication activity and citation is done. Unfortunately, we are not sure that the above list is exhaustive. The existence of several profiles for a scientific institution greatly reduces the accuracy and completeness of received scientometric information degrading the citation indicators. Lack of clear affiliation of institution or author distorts the idea of the organization and scientist in the international community, actually isolates them from participation in the modern global processes being critically important at the time when the overall development of the science (and obtaining a grant funding) and its productivity (transformation of scientific results into innovation) are directly dependent on the international cooperation [7]. Consistent application of multiple filters provides the information on the international cooperation within a specified period. For example, how many publications were made solely by the national scientists and how many with foreign collaborators; what countries and agencies these foreign collaborators came from; how many publications account for each of the countries with which there existed collaboration; how many citations were made on each of the joint publications and others.

According to the WoS CC, the top ten countries with which the Ukrainian scientists pub-

lished the most common articles (information available to the WoS CC for the entire period of 1900–2016) include Russia, Germany, USA, Poland, France, Great Britain, Italy, Spain, Switzerland and Japan. Cooperation with the countries of South America, Africa and the Southeast Asia (Suriname, Trinidad and Tobago, Samoa, Niger) occupied the last place. It is difficult to characterize cooperation with Belarus because we have, at least, four spellings of the name of this country. During the period of 2011–2015, the list of countries whose scientists have most common publications with the Ukrainian scientists virtually remains the same: Russia, Germany, USA, Poland, France, Great Britain, Italy, Spain, China, and Switzerland.

An important aspect of international practice and ethics of publications is disclosure of sources of funding for the research (search field «Funding»). In case when the work is supported by grants from foundations, including the Ukrainian ones and implemented within the framework of national or international projects, it is desirable to indicate this information at the end of the article or on the front page in the main language of publication, as well as in English. This provides the important additional information to find opportunities for scientific cooperation and funding in the various fields of research; this information is one of the grounds to make sound management decisions.

In the considered array of publications (articles from the WoS CC for 2010–2016) it was found a citation to the following sources of funding: The National Academy of Sciences of Ukraine – 71 (a little over 1.5 percent of the total array); STCU – 27; Russian foundation for basic research – 18; NAS of Ukraine – 15; Ukraine State Foundation for Fundamental Research – 12; Ukraine National Academy of Sciences – 10; Science and Technology Center of Ukraine – 9. NAS of Ukraine and the State Fund of Fundamental Research appear several times in different spellings in the list of sources of funding. Note that the implementation of the planned research within the basic and

applied science topics of institutions is a reason for specifying the place of work of the author as an organization that provides funding.

The average citation indicators of publications in the various fields of science are significantly different. A large discrepancy between the citations indicators of publications in the various fields of science depends on many factors. In particular, researchers in the natural sciences publish the results of their research mostly in journals and conference proceedings, unlike the «humanitarians» who prefer monographs. Given that the main content of the WoS CC are scientific journals, the citation rate of publications in the periodicals higher than in monographs.

It is necessary to pay attention to the fact that the subject of scientific research in the social sciences and humanities is usually of local, but not of global significance, and regional studies focused on a particular society or group (regional economics, sociology, linguistics, political science, etc.) are important. Accordingly, there are more references in the «humanitarian» publications to the national publications; moreover, a narrower circle of researchers makes citations to them. So, it is incorrect to make comparative analysis of citation indicators of scientists, organizations and periodicals belonging to different spheres of science.

We realized the review of a particular thematic area by direction «Social Sciences» selecting the socio-economic trend which among the humanities research in the WoS CC is the most representative.

The analysis results showed that as of September, 2016, the total number of scientific articles in the thematic sections «Economics & business» and «Social sciences, general» compared with the total number of scholarly articles of all thematic categories makes up 1.8 percent and 5.9 percent, respectively. Among the total number of national publications indexed in the WoS CC, 0.3 percent belongs to the category of «Social sciences, general» and 1.27 percent to «Economics & business». The largest number of the national publications

of these areas fell within 2010–2012. This is due to the fact that in 2010–2012, the Ukrainian magazine «Actual problems of the economy» was included to the WoS CC database.

The average number of citations among all journal publications in the thematic category «Economics & Business» accounts for nearly 2.8 percent and about 2 percent the high-cited publications; in the thematic category «Social sciences, general» the average number of citations to publications makes up 2.3 percent and high-cited ones being almost 6 percent. The publication is considered to be high-cited when it falls into 1 percent of the most cited publications in the world among the papers published in the same year and in the same research sphere. The total number of citations presented in the national publications category «Economics & Business» is 0.2 percent of the total number of citations (high-cited being 0.7 percent); «Social sciences, general» is 0.1 percent (high-cited being 0.2 percent).

There is a direct relationship between the number of publications in the WoS CC database and the total number of citations to them. However, the number of high-cited publications usually depends on the timeliness of the theme and the credibility of edition which contains the publication. In the rating positions of 124 countries whose researchers were published in this field, Ukraine occupied the 89th place by the average number of citations.

The WoS CC analytical tools help to solve the complex problems, in particular, as noted above, to perform a detailed and deep analysis of bibliometric indicators of individual scientists, institutions, journals and countries. The use of automation in the processing of data allows you to avoid errors that appear in the «Manual sampling», but this is possible on condition that the information is submitted completely and correctly (rightly). However, the automated search by country, institution, thematic area often makes it difficult to find in the WoS CC the articles of national scientists which actually exist there. Only performing search by the name of the author or «manual se-

arch» by the publication name we have a chance to find an article written by the scientists of the National Academy of Sciences of Ukraine. The reason is incorrect information regarding the affiliation: incorrectly translated (transliterated) name of institution, no addresses, etc. The system does not identify, for example, the publication of the given author from Ukraine because of simple formal errors.

## CONCLUSION

Summing up the search results in the WoS database of scientific research of employees of the NAS of Ukraine we conclude that one of the reasons of extremely low indicators by all areas of science is a false identification, namely:

- ✦ existence of several profiles of the NAS of Ukraine significantly affects the completeness and reliability of scientometric information;
- ✦ errors in the affiliation of organization complicate the legitimization of scientific knowledge, definition of role of institutions in shaping the research directions and impede the institution to implement the important social and expert functions in the modern global world;
- ✦ many options specifying surnames and first names of scientists (including non-unified names of organizations) lead to the dispersion of indicators of publication activity and citation, confusion between the authors with the same surnames and last names.

The analysis of information on the publications of the NAS of Ukraine in the WoS CC showed that the pressing issue is to correct the existing common mistakes and implement the measures that will ensure the unification of the profiles of scientists, research institutions, scientific journals and the NAS of Ukraine, in general. This unification will lead to streamlining of already existing WoS CC information that will help to get much higher and realistic indicators of publication activity and citation than one can observe today. Bringing the existing indicators in line with the facts will contribute to the improvement of scientometric quality of the national publications in the future.

The survey allows us to formulate several priority recommendations:

1. National scientists should actively create the personal profiles on the international resources (ORCID (Scopus) or Researcher ID (WoS)) which make it possible to correctly identify the existing and future publications of specific scholar and organizations where he works. Profiling for an individual user is free, and the above-mentioned systems are equivalent. It is worth noting that many organizations that provide grants for research, consider such profile as binding;

2. Authors of scientific publications should correctly indicate a source of research funding, that is, to correctly indicate the names of organizations that provide funding;

3. Scientific journals should arrange the modern web resources, gain the ISSN international standard codes for these electronic versions; should apply the Ulrich's international catalogue with request to merge the profiles of the journal for the entire period of its existence (by all names, ISSN, publishers, institutions-founders); introduce a system of digital identifiers of the DOI articles;

4. Academic councils of research institutions should monitor the correctness of the appropriate name of your scientific institution in all individual publications and their own scientific journals recommended for printing;

5. If you have access to the WoS scientific institutions you should create your own profiles in this database.

Results of scientometric studies can lead to unexpected and interesting findings both for the scientists and administrators of science. From standpoint of science management, promising is the study of publication relations; the analysis makes it possible to reveal the actual structure of the networks and their influence on the development of science, as well as enables you to assess the organizational and institutional conditions required to increase the intensity of scientific communication between the scientists.

After the required «error correction» in the WoS and acquisition of correct and timely infor-

mation about the level of representation of the NAS of Ukraine publications in the rating editions one can analyze how trends of the NAS of Ukraine publication activity and its individual institutions are associated to the scientific fields by which the greatest amount of studies, publications and citations were made. Also, there is a chance to identify the most influential periodicals, scientific institutions that perform similar studies and actively report their results, as well as to find organizations that provide funding to solve the specific scientific problems for each actual and promising direction.

A significant advantage of the available WoS information can be gained for the development of publishing trade of the Academy and some research institutions, namely, to identify the editions, publications which are subject to stimulation, to find new authors and members of editorial boards and reviewers who can be involved in the work of our publishing trade. For example, as for today, we have the most of citations to the reviews, namely, the scientific publications which have in-depth study of development of current research by a specific scientific direction for the publications not older than five years. The number of citations in the list of publications of such articles may exceed one hundred. Such reviews written by the prominent scientists greatly enhance the ranking and level of citations to publications. Instead, the NAS of Ukraine journals included in the WoS CC are focused primarily on publishing the results of scientific research of the national scientists, mostly on the employees of the same institution which is the publisher of a particular journal. In view of this fact, there is a small number of foreign authors which has negative impact on the ratings of our scientific journals and artificially narrows a possible citation network. A careful analysis of publishing activity of the NAS of Ukraine would help to develop the practical steps to the improvement of its efficiency and effectiveness. However, these studies are possible only with the constant-time access to the relevant scientometric tools.



Using the analytical tools of the WoS scientometric database one can identify the research areas which in the future will produce the breakthrough results and ensure the stable development of science, will make it possible to formulate the most effective publishing strategy to increase «visibility» of the national science, the rankings of research institutions and scientists, and finally, the transformation of scientific results into innovative products and technologies.

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Ю.В. Діденко<sup>1</sup>, А.І. Радченко<sup>2</sup>, Н.В. Коваль<sup>3</sup>

<sup>1</sup> Науково-видавнича рада НАН України, вул. Володимирська, 54, Київ-30, 01601, Україна

<sup>2</sup> ВД «Академперіодика» НАН України, вул. Терещенківська, 4, Київ-4, 01004, Україна

<sup>3</sup> Сектор суспільних наук НОВ, Президія НАН України, вул. Володимирська, 54, Київ-30, 01601, Україна

#### ІНФОРМАЦІЙНА СИСТЕМА WEB OF SCIENCES: ДЗЕРКАЛО ЧИ ІНСТРУМЕНТ?

Коротко охарактеризовано ступінь присутності та «видимості» наукових статей українських вчених у базі даних Web of Sciences Core Collection. Огляд здійснено для категорії «Наукова стаття» у вибірці «Україна». Основну увагу приділено періоду 1991–2016 рр. Означено основні причини низької «видимості» вітчизняних наукових публікацій у цій базі. Запропоновано початкові кроки для вирішення проблемних питань.

*Ключові слова:* наукова стаття, наукова публікація, індекс цитування, Національна академія наук України, Web of Sciences Core Collection.

Ю.В. Діденко<sup>1</sup>, А.І. Радченко<sup>2</sup>, Н.В. Коваль<sup>3</sup>

<sup>1</sup> Научно-издательский совет НАН Украины, ул. Владимирская, 54, Киев-30, 01601, Украина

<sup>2</sup> ИД «Академперіодика» НАН Украины, ул. Терещенковская, 4, Киев-4, 01004, Украина

<sup>3</sup> Президиум НАН Украины, Сектор общественных наук, ул. Владимирская, 54, Киев-30, 01601, Украина

#### ІНФОРМАЦІОННА СИСТЕМА WEB OF SCIENCE: ЗЕРКАЛО ІЛИ ІНСТРУМЕНТ?

Кратко охарактеризована степень присутствия и «видимости» научных статей украинских ученых в базе данных Web of Science Core Collection. Обзор осуществлен для категории «Научная статья» в выборке «Украина». Основное внимание уделено периоду 1991–2016 гг. Обозначены основные причины низкой «видимости» отечественных научных публикаций в этой базе. Предложены начальные шаги для решения проблемных вопросов.

*Ключевые слова:* научная статья, научная публикация, индекс цитирования, Национальная академия наук Украины, Web of Science Core Collection.

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