Scientometric Indices of Chemical Institutes of the Novosibirsk Scientific Centre of SB RAS during the Years 1995–2003 According to the Data of Science Citation Index and Chemical Abstracts

V. M. BOUZNIK[1,2], I. V. ZIBAREVA[2], N. I. SOROKIN[4] and L. S. FILATOVA[3]

[1]*Boreskov Institute of Catalysis, Siberian Branch of the Russian Academy of Sciences, Pr. Akademika Lavrentyeva 5, Novosibirsk 630090 (Russia)*

E-mail: bouznik@ngs.ru

[2]*Innovation Centre, Russian Academy of Sciences, Pr. Semenova 1, Moscow Region, Chernogolovka 142432 (Russia)*

[3]*Vorozhtsov Novosibirsk Institute of Organic Chemistry, Siberian Branch of the Russian Academy of Sciences, Pr. Akademika Lavrentyeva 9, Novosibirsk 630090 (Russia)*

[4]*Presidium, Siberian Branch of the Russian Academy of Sciences, Pr. Akademika Lavrentyeva 17, Novosibirsk 630090 (Russia)*

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Abstract

The scientometric indices of six chemical institutes of the Novosibirsk Scientific Centre of SB RAS for the years 1995–2003 obtained by means of the search in the databases of Science Citation Index and Chemical Abstracts of the international scientific and technical net (STN International). The indices take into account the number of publications, their citation rates and impact factors of journals (taken from the Database of Journal Citation Reports) in the absolute representation and in the specific one (per one researcher per one year). The main subjects of investigation are revealed, national and international scientific collaboration is marked. The scientific journals were revealed in which the investigation results obtained by the researchers from the institutes under examination were published most frequently. The indices thus obtained allow us to estimate the dynamics of scientific productivity of the institutes. The indices under analysis are compared with the All-Russian indices whenever possible.

INTRODUCTION

Estimation of the results of scientific activities is a complicated process, which is not always unbiassed, especially in the case of fundamental research under analysis. At the same time, these estimations are necessary both for the determination of the efficiency of each researcher, a scientific institution or a national scientific community, and for introspection. This procedure, though not always incontrovertible, can be carried out according to different procedures combining quantitative characteristics and qualitative evaluations [1–5]. As a rule, the latter ones represent the opinion of experts while the former ones are quantitative (sciencemetric) indices [6]. These indices originate from the databases generated by the Institute for Scientific Information (ISI) (USA), and first of all Science Citation Index (SCI) [7] and Journal Citation Reports (JCR) [8]. The database of Chemical Abstracts (CA) [9] published by

Chemical Abstract Service (CAS, USA) is also an important source of scientometric indicators for chemical sciences. It is natural to assume that in the case when the scientometric indices coincide (correlate) with the opinion of experts they may be used to estimate the scientific activities at any level from a single researcher to an entire state. Taken separately, these estimations may differ from the actual situation and lead to essential mistakes [1–5].

Scientific productivity is usually expressed as the number of publications per a definite time interval, first of all in the core journals abstracted by the ISI, taking into account (if a more careful analysis is necessary) the impact factors of journals [10]. The impact of a scientific work on the professional community is characterized as a first approximation by citations of the corresponding publications, that is, both by the general number of citations and by the mean number of citations of a published work (citation index) [11].

Since scientometric indicators are fully retrospective, they are applicable to a higher extent to the estimation of the fulfilled (executable) research programmes than to future research planning, though the latter should be carried out accounting for the analysis of previous results. Since the publication and citing activities in different research areas differ significantly, these indicators are reasonably applicable only to separate disciplines (groups of related disciplines) and are unsuitable for interdisciplinary comparison [1–5].

The goal of the present wok is scientometric description of the activities of chemical institutes (below referred to as CI) of the Novosibirsk Scientific Centre (NSC), SB RAS, involving the databases of SCI and CA. The years under investigation are 1995–2003; CI include Institute of Catalysis (IC), Institute of Inorganic Chemistry (IIC), Institute of Chemical Kinetics and Combustion (ICKC), Institute of Solid State Chemistry and Mechanochemistry (ISSCM), International Tomography Centre (ITC) and Novosibirsk Institute of Organic Chemistry (NIOC). The scientometric indicators are the number of publications (including patents), impact factors of the corresponding journals, the number of citations, per cent of citation of the publications, and some other indices, both in the absolute and in specific representations. The data extracted from the databases of SCI and CA are compared with the data from annual reports submitted by CI to the United Academic Council on Chemical Sciences of SB RAS (UAC).

METHODOLOGY

The initial statistics were obtained as a result of the online search carried out in April and June 2004 (for 1995–2002) and in January 2005 (for 2003) over the databases of SCI and CA available through the global scientific and technical net STN International [12].

The SCI Database [7] abstracts ~5600 leading journals in natural science, technology and medicine, and the proceedings of some conferences with a retrospective view down to 1974, the CA Database [9] contains the abstracts from about 9000 scientific journals in all the chemical and adjacent disciplines with a retrospective view down to 1907, as well as patents, proceedings of conferences, reports, books and dissertations.

The combined use of two databases has an advantage over separate work with any one of them. First, the SCI DB and CA DB complement each other providing a more complete selection of the publications of CI under investigation. The combined use of both databases allows us to minimize always-occurring errors of informa-tion input. Second, each DB has its own specific features, and the combined use of both data-bases allows one to obtain a more complete set of scientometric indicators, which promotes comprehensive coverage of the scientific activities of CI under investigation. For ins-tance, one can examine international collabora-tion using the SCI Database because places of employment of all the authors of journal articles are indicated, while only the employ-ment of the first author of an article is given in CA Database (for patents, it is given for all the authors). In turn, the CA Database contains a thesaurus of controlled terms allowing one to investigate subjects of publications. Search for citation is possible in both DB: SCI takes into account citing of publications since 1974 while CA since

1998. The command language of STN allows one to carry out a search for publications in two DB and convert the obtained information into the reference format in order to find the citing publications for them. In doing this, of course, it is possible to compare the data on citation from both databases.

In the present work, the primary search was carried out in the SCI and CA Databases over non-standardized polyvariant (as named in original articles and patents) names of CI under investigation with indications of their affiliation with the NSC, SB RAS, in order to achieve unambiguity. Numerous errors in the databases were revealed in attributing publications to institutes, which required careful hand editing. in particular, the SCI DB not always distinguishes NIOC from IIC, SB RAS. The errors were reported to the Help Desk services of STN.

In order to compile ordered summary tables and to carry out subsequent offline analysis of the data file (more than 6700 publications of CI under investigation and about 19 000 publications citing them), STN Messenger command language was used (commands: Analyze, Transfer and Tabulate) [13]. Reduplication of the publications connected with partial coincidence of the lists of journals abstracted by SCI and CA was eliminated by comparing the search results. Only formatted unique (non-repeating) references were used in subsequent analysis. The impact factors of journals were taken from the JCR DB [8].

Self-citations were not excluded when analyzing citations of publications because one might have lost mutual citations of different research groups from one CI. It was shown in [14, 15] that self-citation has almost no effect on macroscopic bibliometric indices. In addition, in leading journals, tough reviewing excludes unrea-sonable (in the opinion of reviewers and editors) self-citation while reasonable self-citation is turned into a useful indicator of the activity and expertise of authors [2].

It follows from the above-considerations that publications of the employees of CI with the first author from another institution in the issues not abstracted by SCI are not identified by the search. This provides some under-estimation of scientometric indices, but it is this view in which CI appear before the major part of the world scientific community.

The data found in SCI and CA Databases were compared with the data contained in annual reports submitted by CI to the UAC. When calculating specific indices of CI, we used the data of the UAC on the number of researchers.

RESULTS AND DISCUSSION

Science-metric analysis of the state of fundamental research in Russia at the boundary of the 20s and 21th centuries provides evidence of a substantial decrease in the productivity and in the influence on the development of the corresponding research areas [16–20]. According to the Database of National Science Indicators (NSI) generated by ISI, Russia occupied the eighth position in 1996–2000 (after USA, Great

TABLE 1

Selected scientometric indices in 1996–2000 for some leading countries (NSI DB) [20]

No.	Index	Russia	USA	Japan	Germany
1	Number of publications, % of the world number	3.52	35.32	9.17	8.64
2	Number of publications per 1000 inhabitants	0.84	4.66	2.30	3.28
3	The same per 1 mln dollars of GDP	0.18	0.17	0.10	0.17
4	Number of cited publications, %	37.75	63.01	57.82	60.73
5	Mean number of citations of a publication (Impact index),	1.58	5.58	3.47	4.42
	including chemistry		0.95	9.12	
6	Number of publications, % of the world number:				
	chemistry	7.02	22.89	12.14	10.57
	materials science	4.32	24.73	15.04	9.52
	pharmacology	0.32	32.78	12.74	7.57

Note. The best values for the indices: No. 1 – USA, No. 2 – Switzerland (8.14), No. 3 – Israel (0.45), No. 4 – Sweden (66.21), No. 5 – Switzerland (6.25).

TABLE 2

Indices of scientific productivity of chemical institutes of NSC, SB RAS, in 1995–2003

Years	Number of researchers	Number of publications (without patents)			
		UAC	SCI + CA (unique references)	(SCI + CA)/UAC, %	Calculated per one researcher
			IC		
1995	376	256	241	94	0.64
1996	357	219	249	114	0.70
1997	342	236	260	110	0.76
1998	354	283	275	97	0.78
1999	362	268	262	98	0.72
2000	363	352	338	96	0.93
2001	358	266	253	95	0.71
2002	362	348	256	74	0.71
2003	350	441	319	72	0.91
Mean	358	297	273	94	0.76
1995–2003		2669	2453	92	
			IIC		
1995	310	170	160	94	0.52
1996	303	171	171	100	0.56
1997	303	216	195	90	0.64
1998	269	239	202	85	0.75
1999	266	246	196	80	0.74
2000	260	286	260	91	1.00
2001	258	267	236	88	0.91
2002	244	275	217	79	0.89
2003	242	294	224	76	0.93
Mean	273	240	207	86	0.77
1995–2003		2164	1861	86	
			ICKC		
1995	158	109	86	79	0.54
1996	146	121	113	93	0.77
1997	144	173	124	72	0.86
1998	130	133	104	78	0.80
1999	137	143	108	76	0.79
2000	135	140	116	83	0.86
2001	131	170	116	68	0.89
2002	125	125	104	83	0.83
2003	127	128	97	76	0.76
Mean	137	138	108	79	0.79
1995–2003		1242	968	78	
			ISSCM		
1995	93	61	60	98	0.65
1996	91	76	79	104	0.87
1997	92	83	95	114	1.03
1998	89	97	95	98	1.07
1999	86	99	74	75	0.86
2000	97	104	99	95	1.02
2001	95	130	101	78	1.06
2002	90	111	71	64	0.79
2003	91	126	86	68	0.95
Mean	92	99	84	88	0.92
1995–2003		887	760	86	

TABLE 2 (continued)

Years	Number of researchers	Number of publications (without patents)			
		UAC	SCI + CA (unique references)	(SCI + CA)/UAC, %	Calculated per one researcher
		ITC			
1995	20	27	25	93	1.25
1996	20	9	10	111	0.50
1997	26	28	18	64	0.69
1998	24	12	11	92	0.46
1999	26	27	21	78	0.81
2000	26	33	19	58	0.73
2001	24	30	31	103	1.29
2002	28	37	35	95	1.25
2003	26	37	27	73	1.04
Mean	24	27	22	85	0.89
1995–2003		240	197	82	
		NIOC			
1995	173	93	89	96	0.51
1996	166	95	75	79	0.45
1997	164	107	99	93	0.60
1998	157	92	87	95	0.55
1999	154	89	75	84	0.49
2000	160	120	114	95	0.71
2001	159	141	126	89	0.79
2002	158	129	109	84	0.69
2003	147	138	106	77	0.72
Mean	160	112	98	88	0.61
1995–2003		1004	880	88	

Britain, Japan, Canada, France and Italy) among the leading scientific countries (for chemical publications, China comes instead of Italy in this list [21]). Among 18 disciplines of Natural Sciences, according to the list of classification headings of NSI DB, the contribution from Russia is especially significant in physics (the 4th position), astrophysics, chemistry and geological sciences (the 5th position). Some scientometric indices of 1996–2000 (with special attention to chemistry and such adjacent areas as materials science and pharmacology) are listed in Table 1. It may be noted that with the observed decrease in indices Russia produces more publications per 1 mln dollars of GDP (gross domestic product) than USA, Germany or Japan [20].

According to the data of ISI for 1996–2000, articles from Russia accounted for 3.57 % of the world publications in leading journals in natural and social sciences, among them articles in chemistry accounted for 6.78 %. In all the research areas taken into account by ISI, the impact factors of Russian publications are much lower than the world mean level (by 64 % for chemistry) [17].

Productivity indices

The indices of scientific productivity of CI of NSC SB RAS for 1995–2003 are listed in Table 2 and in Fig. 1. They include the general number of unique publications (without patents which are considered separately below) found in SCI and CA DB, number of publications per one researcher, and percentage of publications found in DB in comparison with the publication lists submitted by institutes themselves. The latter index provides an indirect measure of the quality of scientific production of CI (the fraction of publications in high-level journals abstracted by SCI and CA DB) and the leading role of CI employees in the joint publications (in the case if the authors of an article are ranged not alphabetically but according to the contributions into the work which is quite

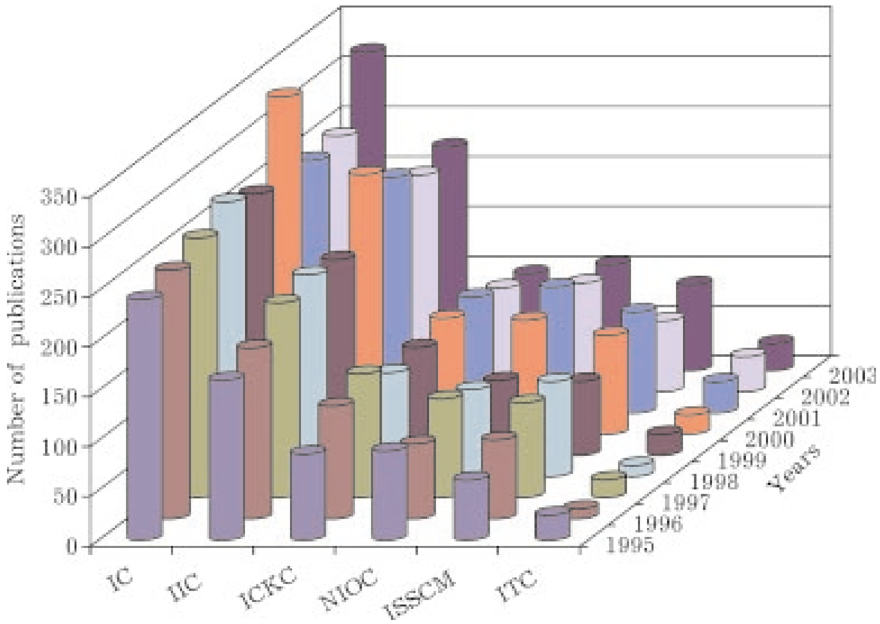

Fig. 1. Distribution of the number of publications of CI of NSC, SB RAS (unique references, SCI and CA DB), over years.

typical for chemistry). The indices may be affected by a large number of conference proceedings, especially domestic ones that are accounted by CI but not fully depicted in DB.

An interesting general trend (see Table 2 and Fig. 1) is conservation (or even a slight increase) in the number of publications with a decrease in the number of researchers. Within the investigated years, mean number of researchers in CI differed by more than an order of magnitude: from 24 in ITC to 358 in IC. In this situation, the number of researchers remained almost constant during the years 1995–2003 in ITC and in ISSCM, while it somewhat decreased in IC, IIC, ICKC and NIOC (see Table 2). One should also stress a

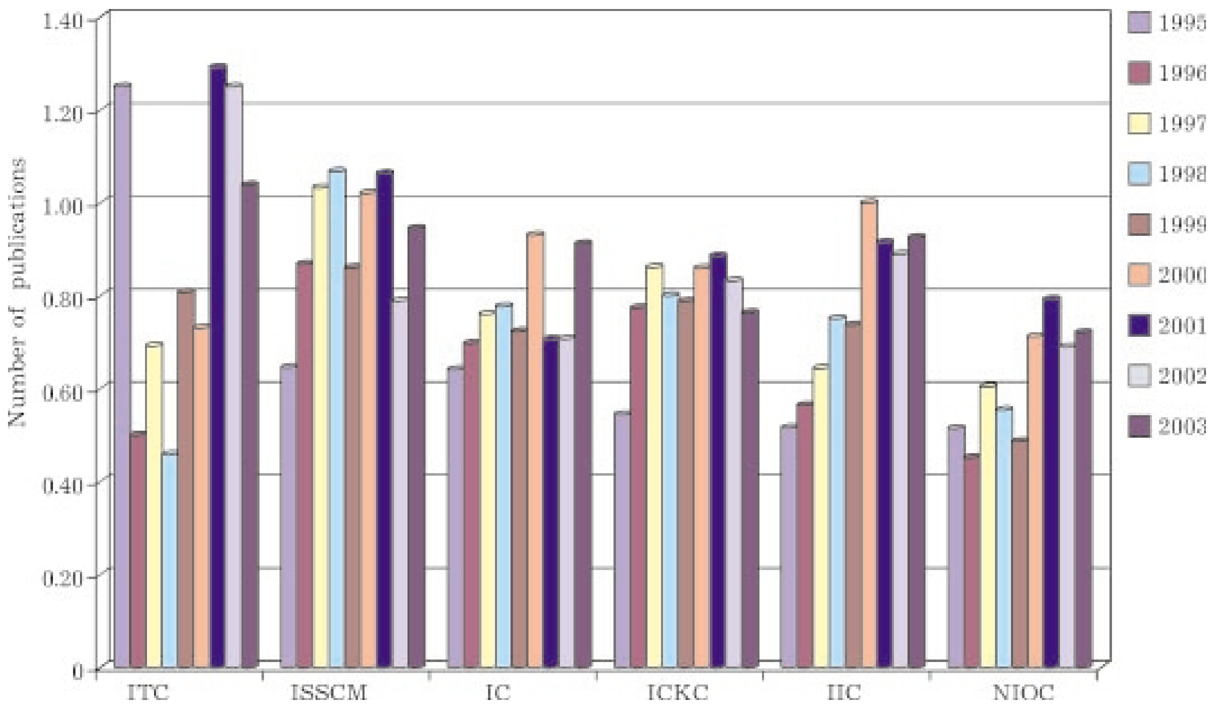

Fig. 2. Number of publications per one researcher per one year in CI NSC, SB RAS.

TABLE 3

Citations of scientific publications of CI NSC, SB RAS, of 1995–2003 during the same period.

Year	Citation index of institutes*					
	IC	IIC	ICKC	ISSCM	ITC	NIOC
1995	1745/1457	706/569	589/453	130/88	170/141	290/245
1996	1333/1339	534/454	572/564	313/217	73/79	183/185
1997	1324/1394	611/582	742/809	261/152	94/96	290/324
1998	1179/1307	649/648	550/581	223/173	67/71	196/215
1999	1134/1232	607/657	517/554	110/97	138/150	166/170
2000	1013/1086	481/490	285/304	160/139	84/101	221/240
2001	425/474	332/380	216/237	90/77	75/83	179/194
2002	245/259	104/128	69/70	42/41	36/44	57/63
2003	42/45	17/18	16/17	12/6	3/3	11/17
1995–2003	8440/8593	4041/3926	3556/3589	1341/990	740/768	1593/1653

*The first value relates to SCI DB, the second to CA DB.

strong (nearly three-fold) variation of the indices from year to year for ITC. This may be connected with the young age of this institution.

Mean specific scientific productivity (mean number of unique publications according to the data of SCI and CA DB, calculated per one researcher per one year, see Table 2 and Fig. 2) noticeably varies for CI under investigation changing from 0.92 for ISSCM to 0.61 for NIOC. As far as one may conclude, the productivity at a level of 0.5–1 is rather typical for modern Russian institutes carrying out (like CI of NSC, SB RAS, for example) mainly labour-intensive experimental research work. In particular, the indices of NIOC for 2000–2003 are quite comparable with the indices of N. D. Zelinskiy IOC, RAS (Moscow) [22]. It is interesting to note that the specific indices of CI with small number of researchers turned out to be higher.

Citation of publications as an index of impact

The data of the two DB on citation of research publications of CI correspond to each other and demonstrate a clearly exhibited cumulative effect: an increase in the number of citations with time (Table 3, Fig. 3).

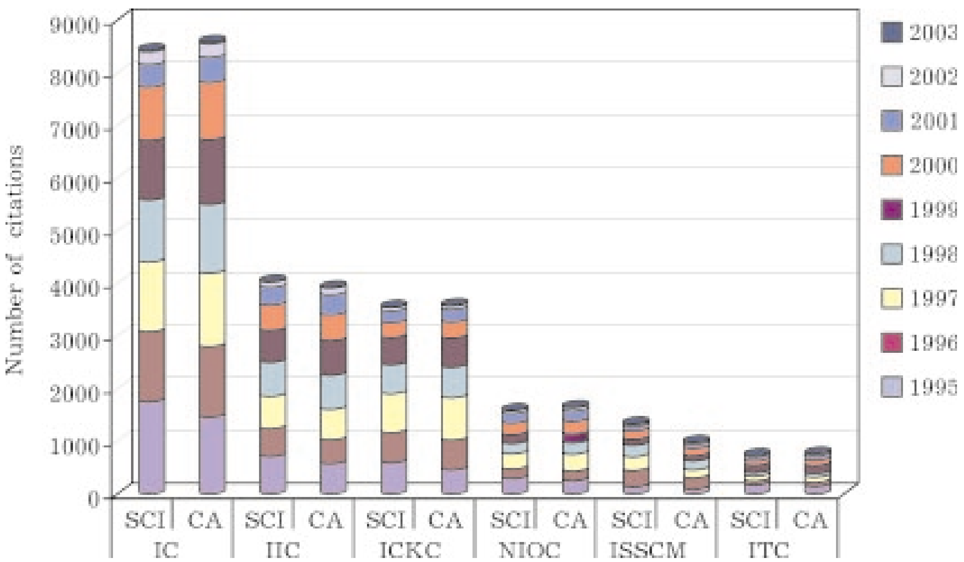

Fig. 3. Citation of publications of CI NSC, SB RAS, in 1995–2003.

TABLE 4

Impact index for publications of CI NSC, SB RAS, in 1995–2003

CI	Number of publications (without patents)	Number of citations for the same period in DB		Impact according to DB		Number of cited works in DB*, %	
		SCI	CA	SCI	CA	SCI	CA
IC	2453	8440	8593	3.44	3.50	57 (68)	56 (68)
IIC	1861	4041	3926	2.17	2.11	48 (59)	48 (58)
ICKC	968	3556	3589	3.67	3.71	60 (71)	58 (69)
ISSCM	760	1341	990	1.76	1.30	47 (56)	41 (49)
ITC	197	740	768	3.76	3.90	59 (80)	60 (80)
NIOC	880	1593	1653	1.81	1.88	52 (65)	53 (68)

*The data for 1996–2000 are shown in parentheses.

A simple method to estimate the use of published results in obtaining new knowledge is a ratio of the number of citations to the number of articles for a definite time interval [23] (Impact index [18–20]). The corresponding data for CI are listed in Table 4 (for the All-Russian index of Impact index for 1996–2000, see Table 1).

The mean institute index of Impact for 1995–2003 varies within a broad range: from 3.76 (SCI) and 3.90 (CA) for ITC to 1.76 (SCI) and 1.30 (CA) for ISSCM (see Table 4). This provides one more confirmation of the fact that citing can differ substantially depending of the subjects of investigation even within one scientific discipline.

A direct comparison is possible for the databases of SCI and NSI, which use the same nomenclature of journals. This comparison proves that the indices of CI (see Table 4) exceed (in the majority of cases to a substantial extent) the similar indices for Russia in general (see Table 1). For instance, the percentage of cited publications in 1996–2000 for CI is 1.5–2 times higher than the percentage for Russia in general (see Tables 1 and 4).

Identification of the most cited publications of CI NSC, SB RAS, in combination with evaluations is likely to allow us to reveal new actual directions of research and their leaders, which can be the subject of investigation in each specific institute.

The most frequently used scientific journals — Impact-1 and Impact-2 indices

A list of scientific journals, which most frequently publish the articles of CI, characterizes not only the subject but also the level of investigations. For each CI, unique journals were revealed the list of which con-tains as a mean from 14 (ITC) to 89 (IC) journal names (Table 5). So, the scientific information generated by CI is distributed over a broad range of periodicals.

A core was revealed; it is composed of the journals in which CI were published most frequently. Ranged lists including 10 journals

TABLE 5

Number of unique journals publishing the works of CI NSC, SB RAS, in 1995–2003

CI	Year of publication									Mean
	1995	1996	1997	1998	1999	2000	2001	2002	2003	
IC	67	85	81	69	94	103	89	99	110	89
IIC	56	58	72	71	70	89	94	79	81	74
ICKC	44	57	57	55	56	59	57	52	57	55
ISSCM	25	32	35	32	29	43	35	40	53	36
ITC	16	7	12	8	15	14	16	18	17	14
NIOC	36	25	28	35	31	43	47	43	42	37

TABLE 6

Scientific journals most frequently publishing the works of CI NSC, SB ARS, during 1995–2003, and their citations for the same period

Journal title	Number of published articles (SCI DB + CA DB)		Number of citations according to DB		Mean impact factor of a journal in 1996–2003
	Abs.	%	SCI	CA	
IC					
Kinetics and Catalysis	276	11.25	260	298	0.532
Reaction Kinetics and Catalysis Letters	224	9.13	632	616	0.481
Journal of Molecular Catalysis, A	127	5.18	666	715	1.654
Catalysis Today	74	3.02	541	592	1.994
Chemistry for Sustainable Development	72	2.94	23	22	–
Studies in Surface Science and Catalysis	68	2.77	133	143	1.198
Catalysis Letters	63	2.57	594	592	1.972
Nuclear Instruments & Methods in Physics Research, Section A	58	2.36	128	119	1.009
Journal of Structural Chemistry	54	2.20	42	38	0.404
Surface Science	50	2.04	354	352	2.272
IIC					
Journal of Structural Chemistry	333	17.79	299	336	0.404
Russian Journal of Inorganic Chemistry	133	7.15	192	161	0.339
Russian Journal of Coordination Chemistry	81	4.35	20	38	0.449
Chemistry for Sustainable Development	70	3.76	48	44	–
Russian Journal of Physical Chemistry	64	3.44	66	28	0.371
Inorganic Materials	55	2.96	51	66	0.217
Russian Chemical Bulletin	54	2.90	47	57	0.421
Nuclear Instruments & Methods in Physics Research, Section A	40	2.15	72	57	1.009
Proceedings – Electrochemical Society	33	1.77	19	15	–
Mendeleev Communications	30	1.61	122	85	0.686
ICKC					
Chemical Physics Letters	60	6.20	473	494	2.406
Combustion, Explosion and Shock Waves	60	6.20	56	30	0.199
Journal of Chemical Physics	49	5.06	367	383	3.199
Russian Chemical Bulletin	41	4.24	43	54	0.421
Chemical Physics	40	4.13	160	164	1.951
Dokl. Chem./Dokl. Earth Sci./Dokl. Phys. Chem.	33	3.41	36	34	0.151
Applied Magnetic Resonance	28	2.89	96	105	0.731
Chemical Physics Reports	26	2.69	21	21	0.382
Journal of Physical Chemistry, A	24	2.48	154	159	2.598
Journal of the American Chemical Society	20	2.07	336	347	5.960

TABLE 6 (continued)

Journal title	Number of published articles (SCI DB + CA DB)		Number of citations according to DB		Mean impact factor of a journal in 1996–2003
	Abs.	%	SCI	CA	
ISSCM					
Russian Journal of Electrochemistry	69	9.08	3	3	0.096
Inorganic Materials	49	6.45	34	41	0.217
Chemistry for Sustainable Development	49	6.45	23	24	–
Nuclear Instruments & Methods in Physics Research, Section A	46	6.05	90	66	1.009
Solid State Ionics	44	5.79	221	141	1.461
Dokl. Phys. Chem/Dokl. Phys.	42	5.53	90	62	0.151
Russian Journal of Applied Chemistry	38	5.00	30	20	0.161
Journal of Structural Chemistry	34	4.47	20	21	0.404
Russian Journal of Inorganic Chemistry	29	3.82	33	19	0.339
Journal of Materials Synthesis and Processing	23	3.03	49	49	0.388
ITC					
Journal of Structural Chemistry	20	10.15	8	9	0.404
Journal of Physical Chemistry, A	18	9.14	106	100	2.598
Journal of Chemical Physics	13	6.60	129	123	3.199
Chemical Physics Letters	13	6.60	84	82	2.406
Physical Chemistry Chemical Physics	10	5.08	4	7	1.809
Russian Chemical Bulletin	9	4.57	21	23	0.421
Polyhedron	9	4.57	12	15	1.281
Chemical Physics	8	4.06	29	26	1.951
Dokl. Chem./Dokl. Phys. Chem	8	4.06	4	2	0.151
Molecular Crystals and Liquid Crystals Science and Technology. Section A – Molecular Crystals and Liquid Crystals	6	3.05	33	34	0.456
NIOC					
Russian Journal of Organic Chemistry	186	21.14	240	247	0.321
Russian Chemical Bulletin	126	14.32	130	155	0.421
Journal of Fluorine Chemistry	43	4.89	115	123	0.868
Mendeleev Communications	36	4.09	46	39	0.686
Journal of Structural Chemistry	36	4.09	29	18	0.404
Chemistry of Heterocyclic Compounds	35	3.98	21	23	0.387
Chemistry of Natural Compounds	23	2.61	8	7	0.252
Russian Journal of Applied Chemistry	23	2.61	8	7	0.161
Russian Journal of General Chemistry	17	1.93	22	26	0.321
Russian Chemical Reviews	16	1.82	64	74	1.451

for each CI (embracing from 40 to 60 % of papers) are listed in Table 6.

For a number of CI, the core is composed mainly of foreign journals (for IC and ITC 7, for ICKC 6). Among the international journals, the most relevant ones are: Nuclear Instruments and Methods in Physics Research, Section A (IC, IIC, ISSCM) and a group of physicochemical journals: Chemical Physics, Chemical Physics Letters, Journal of Chemical Physics, Journal of Physical Chemistry, (ICKC, ITC); among Russian journals, a specialized Journal of Structural Chemistry is present in five lists of six (IC, IIC, ISSCM, ITC, NIOC), while two multidisciplinary journals (Russian Chemical Bulletin (IIC, ICKC, ITC, NIOC) and Chemistry for Sustainable Development (IC, IIC, ISSCM)) are present in four and three lists, respectively. Two journals among the Russian ones are published in NSC (for bibliometric analysis, see [24, 25]). It follows from Table 6 that the Russian journals are cited much poorer than the foreign ones.

In addition to the simple Impact index (see above), the scientific production of CI can be evaluated on the basis of mean value (for 1996–2003) of the annual amount of publications multiplied by the impact factors (IF) of the corresponding journals for the same years divided by the general number of publications (Impact-1 index) or by the number of researchers (Impact-2 index). Thus calculated indices are listed in Table 7. For the journals not abstracted by SCI DB (that is, having no impact factors in JCR DB), IF was necessarily accepted to be 0. In particular, this relates to "Chemistry for Sustainable Development" (its impact factor calculated independently of ISI was 0.22 in 2002 [25]) and to a number of other journals, and to all conference proceedings.

The Impact indices (see Table 7) are useful for tracking the dynamics of scientific productivity of a separate researcher and of an institute as a whole.

The main subjects of investigation

When compiling databases, publishers supplement the bibliographic information present

TABLE 7

Impact-1 and Impact-2 indices for CI NSC, SB RAS, in 1996–2003

Year	IF × n*	Impact-1	Impact-2	IF × n*	Impact-1	Impact-2	IF × n*	Impact-1	Impact-2
	IC			**IIC**			**ICKC**		
1996	246.72	0.99	0.69	87.18	0.51	0.29	198.36	1.76	1.36
1997	276.40	1.06	0.81	131.05	0.68	0.43	170.65	1.38	1.19
1998	253.44	0.92	0.72	152.11	0.74	0.56	134.74	1.30	1.04
1999	285.06	1.09	0.79	176.98	0.90	0.67	182.49	1.69	1.33
2000	406.70	1.20	1.12	186.64	0.69	0.69	170.92	1.47	1.27
2001	309.22	1.22	0.86	201.56	0.85	0.77	160.42	1.38	1.22
2002	305.36	1.19	0.84	180.64	0.83	0.74	132.94	1.28	1.06
2003	355.62	1.11	1.02	220.97	0.99	0.91	127.59	1.32	1.00
Mean	304.82	1.10	0.86	159.91	0.77	0.63	159.76	1.45	1.18
	ISSCM			**ITC**			**NIOC**		
1996	35.27	0.45	0.39	21.73	2.17	1.09	51.73	0.69	0.31
1997	58.82	0.62	0.64	26.52	1.47	1.02	76.12	0.77	0.46
1998	52.75	0.56	0.59	16.01	1.46	0.67	53.99	0.62	0.34
1999	27.10	0.37	0.32	28.52	1.36	1.10	50.25	0.67	0.33
2000	52.25	0.53	0.54	30.13	1.59	1.16	95.03	0.83	0.59
2001	55.09	0.55	0.58	50.43	1.63	2.10	102.04	0.81	0.64
2002	37.79	0.53	0.42	56.97	1.63	2.03	74.45	0.68	0.47
2003	39.03	0.45	0.43	44.06	1.63	1.69	91.03	0.86	0.62
Mean	44.76	0.51	0.49	34.30	1.62	1.36	73.45	0.74	0.47

*n is number of publications (SCI DB + CA DB).

TABLE 8

Controllable terms of publications of CI NSC, SB RAS, in 1995–2003 (according to CA DB)

Controllable term	Number of publications (including patents)	Number of mentions
	IC	
Oxidation catalysts	304	308
Catalysts	250	255
Oxidation	163	171
Adsorption	134	140
Heteropoly acids	87	100
Simulation and modeling, physicochemical	90	90
Hydrogenation catalysts	89	89
Adsorbed substances	87	87
Polymerization catalysts	85	85
Catalysts and catalysis	76	76
	IIC	
Crystal structure	409	412
Molecular structure	351	354
Cluster compounds	116	122
Thermal decomposition	108	108
Heat capacity	61	68
Clathrates	54	67
Hydrates	51	67
Vapor deposition process	63	64
Entropy	59	60
Phase diagram	56	57
	ICKC	
Combustion	69	69
Photolysis	66	68
Simulation and modeling, physicochemical	65	65
Radical ions	50	58
ESR (electron spin resonance)	54	54
Fluorescence	43	43
Flame	40	41
Propellants (fuels)	33	33
Magnetic field effects	32	32
Air pollution	21	31
	ISSCM	
Crystal structure	42	42
Mechanochemical reaction	39	39
Electrodeposition	37	37
Electric conductivity	35	35
Ceramics	27	34
Electrodes	34	34
Mechanical alloying	33	33
Mechanical activation	30	30
Adsorption	27	29
Carbon fibers, uses	21	21

TABLE 8 (continued)

Controllable term	Number of publications (including patents)	Number of mentions
	ITC	
Crystal structure	32	32
Molecular structure	29	29
CIDNP (chemically induced nuclear polarization)	26	26
Photolysis	26	26
Electron transfer	17	22
Nuclear polarization	17	18
Radicals, properties	16	16
Imaging	15	15
ESR (electron spin resonance)	14	14
Magnetic field	14	14
	NIOC	
Molecular structure	71	72
Crystal structure	61	61
NMR (nuclear magnetic resonance)	34	43
Rearrangement	34	36
Aromatic compounds	20	26
Cyclization	23	25
Substituents effects	25	25
IR spectra	21	21
Alkylation	19	20
Heterocyclic compounds	20	20

in an original journal (authors, title, source of publication, *etc.*) with controllable terms (subject titles, key words, *etc.*) to achieve the most precise characterization of the essence of publications. The use of this information allows one to carry out analysis in the directions, objects and methods of research. Subject titles most fre-quently occurring in the publications of CI according to CA DB are listed in Table 8, with 10 subjects for each institute. These top 10 terms embrace 14 to 25 % of the total number of mentioned controllable terms (14 – NIOC, 15 – ISSCM, 16 – ICKC, 20 – IC, 25 – IIC and ITC each). Prevailing terms are: crystal structure (IIC, ISSCM, ITC, NIOC), molecular structure (IIC, ITC, NIOC), adsorption (IC, ISSCM), ESR (ICKC, ITC), photolysis (ICKC, ITC), physicochemical simulation and modeling (IC, ICKC).

Scientific collaboration

The SCI Database which lists workplaces of all the co-authors of a publication indicating the so-called leading author (identified by the term “reprint”) allows us to estimate involve-ment of the researchers from CI into national and international research collabo-ration (Table 9). In the majority of cases (from 74 % for ISSCM to 54 % for NIOC) the leading authors work in CI themselves. In this situation, from ~100 % (ITC) to 42 % (IC) publications involve co-authors from other Russian Institu-tions and from 68 % (ICKC) to 27 % (ISSCM) involve foreign co-authors. So, the investigated CI noti-ceably participates in international scientific collaboration the results of which are well represented in the leading journals. The ranged lists of the states most important in this sense (5 for each CI and from 63 % (IC, IIC) to 82 % (ITC) of the corresponding papers) look like follows: IC – Germany, Sweden, USA, Italy, France; IIC – Germany, Great Britain, USA, Japan, Canada; ICKC – USA, Germany, Japan, the Netherlands, Israel; ISSCM – USA, Germany, Great Britain, South Korea, France; ITC – USA, Germany, France, Great Britain, Israel; NIOC – Germany, USA, Kazakhstan,

TABLE 9

Scientific collaboration of CI NSC, SB RAS, according to the data of publications during 1995–2003 (according to SCI DB)

CI	Number of publications	Number of institutions per one publication	Leading author works in a CI, %
IC	2112	2.07	66
IIC	1534	2.09	73
ICKC	832	2.39	65
ISSCM	763	1.65	74
ITC	176	2.35	66
NIOC	804	2.21	64

Belgium, South Korea. It should be noted that Germany and USA are present in all the lists.

Another aspect of scientific collaboration is represented in Tables 10, 11. In the publications of CI within the period under investigation, the number of unique (not repeated) authors substantially exceeds the number of researchers (see Table 11), especially in the case of ITC, which directly points to the inter-institutional character of research work. The ratio of the number of unique authors to the number of researchers (see Table 11) can be used to characterize the partnership of this kind.

Mean number of co-authors of a publication for CI varies within 3 to 5 (see Table 10), which is quite typical (see [24, 25] and references therein).

A detailed investigation of scientific collaboration in each CI may help in making this collaboration even more efficient.

Patent indices

The innovation potential of fundamental research, to a definite extent characterized by the number of patents, is of special interest.

TABLE 10

Number of authors of publications of CI NSC, SB RAS, in 1995–2003

CI	Non-unique authors		Number of authors per one publication	
	SCI DB	CA DB	SCI DB	CA DB
IC	8941	8857	4.2	4.2
IIC	6631	5942	4.3	4.1
ICKC	3113	2177	3.7	3.4
ISSCM	2332	2235	3.5	3.2
ITC	827	643	4.7	4.7
NIOC	3408	2312	4.2	3.8

TABLE 11

Number of unique authors of publications of CI NSC, SB RAS, in 2003 in comparison with the number of researchers

CI	Number of researchers in 2003	Number of unique authors (SCI DB + CA DB)	Number of unique authors/ number of researchers ratio
IC	350	779	2.23
IIC	242	528	2.18
ICKC	123	233	1.89
ISSCM	91	204	2.24
ITC	26	58	2.23
NIOC	147	305	2.07

TABLE 12

Number of patents obtained by CI NSC, SB RAS, in 1995–2003 (according to CA DB)

CI	Patents obtained*		Fraction of patents in scientific production**, %	
	1995–2003	2003	1995–2003	2003
IC	385	49	18.1	18.6
IIC	51	1	3.5	0.6
ICKC	3	–	0.5	–
ISSCM	59	5	8.3	7.9
NIOC	59	4	9.8	6.2

*Data of UAC (1995–2003): IC – 343, IIC – 61, ICKC – 11, ISSCM – 82, NIOC – 43.

**Ratio of the number of patents to the number of all the publications of an institute found in CA DB during the same period.

It should also be noted that during the recent years an increasing part of the new research data appears in the form of patents but not journal publications [26]. This especially relates to chemical research. According to CAS, 60 % of new chemical compounds in 2004 were described in patents [27]. The fraction of patents in the world scientific literature is steadily increasing, according to the data of CAS. In 2001, the number of patents (144 498) accounted for 23.8 % of the number of journal articles (606 680), while in 2003 it accounted for as much as 25.4 % (164 344 and 646 912, respetively) [26].

The general situation with patenting activities of scientific institutions of RAS, including CI, is considered in [28]. The data on patents of CI are listed in Table 12 (absent for ITC). One can see that, except for IC, patents account for a very small part of the scientific production. Judging from the world practice, it should be noted that the main patent holders are not academic or university organizations but the representatives of corporate science. So, not high indices of research institutes are natural.

Unlike the general situation with publications (see Table 2), the deviation of the data of UAC and CA DB on patents (see Table 12) is rather large, the deviation occurring to both sides.

Number of patent citations is relatively small. The following figures may be mentioned as the best indices: within the years 1995–2003, 385 patents of IC were cited 80 times, according to the CA DB, and 34 times, according to the SCI DB. It cannot be excluded that the patents are much more rarely cited than research papers, and these data depict a general regularity.

CONCLUSIONS

A correct estimation of the significance of research (being) carried out is the necessary element of self-knowledge of the scientific community. Scientometric indices allow one to study temporal variations in the scientific productivity in the qualitative and quantitative aspects (for a separate researcher and for an institute in general), subjects of research, nomenclature and core of the journals used to publish the results, citations of publication and their impact on the community, *etc*. In combination with expert evaluations, these indices can be useful to Academic Councils and administration when developing (correcting) the research policy. It should be kept in mind that the data presented in this paper embrace only a part of the scientometric information collected by present.

The international scientific visibility of institutes is to a large extent determined by the manner in which the results obtained by the institutes are represented in the global databases. Maximally complete extraction of publications from databases is possible only in the case if the title (including appellation), affiliation and address of an institute are presented correctly in the articles. These details allow us to extract only the publications of an institute under consideration without confusing them with the publications of related institutions.

On the basis of scientometric indicators and their comparison with All-Russian and world indices, the state of fundamental research in CI of NSC, SB RAS, during 1995-2003 can be recognized as quite satisfactory, both in the scientific productivity (number of publications) and in the impact on the scientific community (citation number). In the situation with very limited resources of the Russian science, the indices of the chemical research community of NSC, SB RAS, look with dignity, to a substantial extent regardless of unfavourable circumstances.

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REFERENCES

1 W. Marx, H. Schier, W. Wanitschek, *Scientometrics*, 52, 1 (2001) 59.
2 V. A. Markusova, *NTI, ser.1*, 8 (2000) 17.
3 M. V. Alfimov, A. N. Libkind, I. A. Libkind, V. A. Minin, *Vestn. RFFI*, 4 (2001) 5.
4 R. G. Kasimova, *Naukoved.*, 1 (2002) 132.
5 R. G. Kasimova, *Ibid.*, 4 (2002) 187.
6 I. Wormell, in: Encyclopedia of Library and Information Science, Marcel Decker, New York, 2000, vol. 70, suppl. 33, pp. 77–92.
7 STN Database Summary Sheet: SCISearch. URL: http://www.cas.org/ONLINE/DBSS/scisearchss.html
8 JCR® on CD-ROM, Science Edition.
9 STN Database Summary Sheet: CA. URL: http://www.cas.org/ONLINE/DBSS/scisearchss.html
10 E. Garfield, The Impact Factor. URL: http://www.isinet.com/isi/hot/essays/journalcitationreports/7.html
11 E. Garfield, The Concept of Citation Indexing: A Unique and Innovative Tool for Navigating the Research Literature. URL: http://sunweb.isinet.com/isi/hot/essays/citationindexing/1.html
12 URL: http://www.stn-international.de
13 STN Guide to Commands (1997). URL: http://www.stn-international.de/training_center/messenger/commands/Contents.htm
14 W. Glaenzel, B. Thus, B. Schlemmer, *Scientometrics*, 59, 1 (2004) 63.
15 W. Glaenzel, B. Thus, *Ibid.*, 59, 3 (2004) 281.
16 C. S. Wilson, V. A. Markusova, *Ibid.*, 59, 3 (2004) 345.
17 SCI-BYTES: Russian Science 1996–2000. URL: http://in-cites.com/research/2001/november_19_2001-1.html
18 I. V. Marshakova-Shaykevich, *Vestn. RAN*, 70, 12 (2000) 1086.
19 I. V. Marshakova-Shaykevich, *Vopr. Filosofii*, 12 (2002) 64.
20 I. V. Marshakova-Shaykevich, *Otech. Zap.*, 7 (2002). URL: http://magazines.russ.ru/oz/2002/7/2002_07_39-pr.html
21 *Chem. Eng. News*, October 30, 78, 44 (2000) 63.
22 N. V. Krukovskaya, IOKh RAN, Moscow, Private Communication.
23 J. Reedijk, *New J. Chem.*, (1998) 767.
24 V. M. Bouznik, I. V. Zibareva, V. N. Piottukh-Peletskiy, N. I. Sorokin, *Zh. Strukt. Khim.*, 45, 6 (2004) 1142.
25 I. V. Zibareva, B. G. Derendyaev, *Che. Sust. Dev.*, 12, 1 (2004) 119.
26 CAS Statistical Summary 1907–2003. URL: http://www.cas.org/EO/casstats.pdf
27 CAS News Release, November 30, 2004. URL:http://www.cas.org/New1/publitgrowth.html
28 V. M. Bouznik, *EKO*, 11 (2004) 98.