
HISTORY OF ANALYTICAL CHEMISTRY

O.A. Songina and Her Contribution to Analytical Chemistry

V. A. Zakharov

Department of Chemistry, Al-Farabi State University of Kazakhstan,
ul. Karasai batyra 95a, Almaty, 480012 Kazakhstan

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April 17, 2001, is the hundredth birthday of Ol'ga Al'fredovna Songina, one of the leading analytical chemists in the former USSR, a well-known scientist in the chemistry of rare elements and electrochemical methods of analysis, corresponding member of the Academy of Sciences of Kazakh SSR, honored member of the All-Union Mendeleev Chemical Society, honored scientist of Kazakh SSR, doctor of chemistry, professor.

Songina was born in St. Petersburg in a family of engineers. After finishing school, she began to work at the Lug educational department in Leningrad oblast in 1919. Later, in 1922, she worked at the *Krasnyi Vyborzhets* factory in Leningrad and studied at the metallurgical faculty of the Leningrad Correspondence

Industrial Institute of. In 1937, Songina's husband was repressed, and she was deported to Kirgizia. She worked there in pharmaceutical industry since 1938 and, later, simultaneously worked at the Institute of Chemistry of the Academy of Sciences of Kazakh SSR and at the Kirgiz branch of the Leningrad Institute of Electrical Engineering.

During the World War II, Songina took part in the organization of mine laboratories in Tien Shan and in the development of analytic service in those laboratories. She proposed rapid methods for determining molybdenum and tungsten in ores. The results of her research on the determination of rare elements were presented by Songina in her Candidate dissertation, which was defended in 1945 at Kazakh Chemical and Metallurgical Institute in Almaty. After that, she was invited to work at this institute.

In 1945, Songina moved to Almaty and started to work both at Kazakh Chemical and Metallurgical Institute and at the Institute of Chemistry of the Academy of Sciences of Kazakh SSR. Being a metallurgical engineer, she delivered a course of lectures in the metallurgy of rare elements at the Institute of Chemistry of the Academy of Sciences of Kazakh SSR. There she also was engaged in scientific research of mineral raw materials and worked in the field of rare elements. The course of lectures and the results of research made foundation for the monograph *Redkie metally* (Rare metals) published in 1951, which was the first book in that field of science in the USSR. The monograph was republished two times (in 1955 and 1964) as a revised and enlarged edition. Up till now, specialists in the chemistry and technology of rare elements use this monograph.

Since 1950, Songina worked at the Kazakh State University at the Department of Analytical Chemistry and was the Head of the Department of the Chemistry of Rare Elements she established during 1957–1981. The chemistry of rare elements and the analysis of mineral raw materials were the main points of her research. She intensely worked on the method of amperometric titration mostly using solid indicator electrodes. Songina studied platinum, gold, titanium, and tungsten as raw materials for indicator electrodes for various cathode and anode processes. To select the potential of an indicator electrode for titration, she studied the voltam-

metric behavior of mercury, silver, copper, lead, iron, molybdenum, tungsten, iodine, permanganate, chromate ions and some other elements. On the basis of the data obtained, she developed methods for the amperometric analysis of vanadium, bismuth, iron, arsenic, antimony, lead, silver, mercury, and other elements. The results of these investigations were summarized in the Doctor dissertation of Songina, which was defended in 1957 in Moscow State University. The results of research were represented in the monograph *Amperometric Titration in the Analysis of Mineral Raw Materials* published in 1957. The book was two times republished with the inclusion of the new achievements (1967, 1979) and translated into Polish in 1972.

Later, Songina worked in the field of electrochemistry and the analysis of mineral raw materials. She has developed a theory and introduced amperometric titration with solid electrodes into practice, proposed methods of electrochemical phase analysis and voltammetry of solid phases using mineral carbon pasted electrode.

Even at the early stages of the development of amperometric titration using precipitation reactions, she faced the problem of the distortion of the observed amperometric curves compared to the theoretically predicted curves. The revealing of the reasons for the distortion showed that, in polarography and in amperometric titration, both the reactant and a suspension of their poorly soluble compounds can electrochemically discharged on the indicator electrode. When poorly soluble solid substances or minerals are powdered and mixed with a carbon paste, we prepare an electrode using which electrochemical properties can be studied and an electrochemical signal of the mixture can be obtained. Songina and her student V.G. Barikov proposed this mineral carbon-pasted electrode in 1967. The method using this electrode is known voltammetry with mineral carbon pasted electrode, solid-phase voltammetry, and stripping voltammetry of solid substances.

The electrode is widely used in research and for electroanalytical purposes in many organizations. Using this method, Songina and her students studied processes of electro dissolution of noble metals in different acids and complexant solutions and the electrochemical behavior of various oxides, chalcogenides and composites.

Developing the theory and practice of amperometric titration, Songina and her collaborators comprehensively studied the electrochemical behavior of many inorganic and some sulfur-containing organic tartans on different solid electrodes (platinum, gold, graphite). They have found out the character and mechanism of reactions of these titrants with a number of rare, non-

ferrous, noble, and platinum metals (vanadium, molybdenum, tungsten, selenium, tellurium, arsenic, copper, gold, silver, platinum, palladium, iridium, and others), found the optimal conditions for these reactions, and proposed more than 80 procedures for the amperometric determination of various elements. Songina and her collaborators studied redox potentials of many systems in various media and found a relationship between the actual potential difference of a redox system and the rate of the chemical reaction. On the basis of this relationship they developed new methods for the separate amperometric determination of elements similar in chemical properties (arsenic and antimony, selenium and tellurium), and one and the same element in different oxidation states [vanadium (III,IV), platinum (II,IV), and others].

Songina along with M.T. Kozlovskii and D.P. Shcherbov were the founders of the Kazakh school of analytical chemistry. Ol'ga Al'fredovna organized her own scientific school, and her students are developing her ideas. She died on May 7, 1989.

The name of Songina is well known among analysts. She made a noticeable contribution to the development of analytical chemistry. Except for monographs noticed below, she published about 600 articles, got 30 inventor's certificates, supervised 55 candidate and 2 doctor dissertations. She was an organizer of conferences of factorial and industrial laboratory workers in Kazakhstan and Central Asia, which were regularly held in 1945–1971. This tradition was renewed in 1981. Ol'ga Al'fredovna was the head of the Scientific Council of the Academy of Sciences of Kazakh SSR on electrochemical methods of the Synthesis and Analysis of Inorganic Substances. She was a member of the Scientific Council of the Academy of Sciences of the USSR on Analytical Chemistry, the President of republic directorate of All-Union Mendeleev Chemical Society, a member of the editorial board of *Horol Analiticheskoi Khimii* and the editorial board of *Talanta*. Songina was also a member of one of the commissions of the International Union of Pure and Applied Chemistry (IUPAC).

Ol'ga Al'fredovna was a bright talented scientist, a brilliant teacher, and a good organizer. She was an erudite and a charming and kind-hearted person. She was decorated with a medal of Labor Red Banner, some medals and diplomas of honor of the Supreme Soviet of Kazakh SSR.

Scientific readings in the memory of Songina are regularly held at the Department of Chemistry of Al'-Farabi State University of Kazakhstan. A conference on analytical chemistry devoted to the hundredth anniversary of the birth of Songina will be organized in May 2001 in Almaty.