

RA-915⁺ ZEEMAN MERCURY ANALYZER

List of selected publications

A: PAPERS

1989

Ozerova N. A., Mashyanov N. R., Ryzhov V. V., Sveshnikov G. B. et al. **Karpinsky lineament – a through mercury-concentrating structure** // Through Ore-Concentrating Structures / Ed. by M. A. Favorskaya and I. N. Tomson. – Moscow: Nauka ed., 1989. – P. 52–58. (*In Russian*).

1992

Miko S., Durn, G., Palinkaš L. A., Mashyanov N. R., Namjesnik, K., Ilyn, Y. T. **Distribution of mercury, and aerosols of lead and cadmium in the atmosphere of Zagreb** // Mining and Metallurgy Quarterly (Ljubljana) – 1992. – V. 39. – No. 3–4. – P. 369–387.

Abstract: Random monitoring of mercury in the atmosphere of Zagreb in the past three years has resulted in construction of mercury air-pollution maps. The concentrations vary significantly with the seasonal weather changes, midspring maximum values of 50 ng (Hg) m⁻³ rise to over 100 ng (Hg) m⁻³ in the midwinter months. The observed halo of mercury pollution is almost permanently present over the central and eastern parts of the city thus severely impacting the soil through washout and dry deposition. Sampling of particulate airborne matter gave a more complete characterization of heavy metal contamination of the city. Total lead concentrations vary in the range of 140–3400 ng (Pb) m⁻³. Although lead is mainly the product of gasoline combustion, the results show that the influence of certain industries is far from negligible. Cadmium concentration in air ranging from 1 to 3.2 ng (Cd) m⁻³ and pattern of distribution applies that the pollution sources should be found in coal combustion.

1993

Mashyanov N. R. **Atmochemical methods in geochemistry and ecology** // Methods of inorganic gases analysis / Ed. by V. M. Nemets. – St. Petersburg: Khimia ed., 1993. – P. 340–401. (*In Russian*).

1995

Mashyanov N. R., Reshetov V. V. **Geochemical ecological monitoring using remote sensing technique** // The Science of the Total Environment. – 1995. – V. 159. – No. 2–3. – P. 169–175.

Abstract: Geochemical monitoring of the environment using modern analytical methods provides rapid information concerning the distribution of pollutants over large areas. In relation to this, complex ecological investigations of considerable importance are being conducted on board helicopters, cars and other vehicles equipped with remote sensing devices which provide real time determinations of air and ground pollution. Examples of rapid ecological surveys in the St. Petersburg region are given.

Ganeev A. A., Pogarev S. E., Ryzhov V. V., Sholupov S. E., Dreval T. V. **The new method for direct and express determination of mercury in oil, gas condensate, and biological samples** // Ecological Chemistry. – 1995. – No. 4. – P. 122–126.

Sholupov S. E., Ganeev A. A. **Zeeman absorption spectrometry using high frequency modulated light polarization** // Spectrochimica Acta Part B: Atomic Spectroscopy. – 1995. – V. 50. – No. 10. – P. 1227–1236.

Abstract: This paper reports the novel use of Zeeman atomic absorption spectrometry using high frequency modulated light polarization (ZAAS-HFM), its theoretical basis and experimental validation. Due to the high frequency modulation of the analytical and reference signals, the temporal background correction error is reduced below 10^{-5} absorbance units. In addition, the use of ZAAS-HFM enables the operator to increase the apparatus transmittance and therefore to reduce the detection limits and to broaden the dynamic range of the analytical curves.

Ganeev A. A., Ryzhov V. V., Maydurov A. D., Mashyanov N. R. et al. **Direct determination of mercury-organic compounds in the natural gas and air with using of pyrolysis and photolysis** // Vestnik Sankt-Peterburgskogo Universiteta. – 1995. – No. 4. – P. 73–80. (*In Russian*).

1996

Ganeev A. A., Sholupov S. E., Slyadnev M. N. **Zeeman modulation polarization spectrometry as a version of atomic-absorption analysis: potential and limitations** // Journal of Analytical Chemistry. – V. 51. – No. 6. – P. 788–796.

1997

Gosar M., Pirc S., Mashyanov N. R., et al. **Distribution of mercury in atmosphere over Idrija, Slovenia** // Environmental Geochemistry and Health. – 1997. – V. 19. – No. 3. – P. 101–112.

Abstract: Idrija mine, the second largest mercury mine in the world, was in use since 1490. More than 107 000 tons of Hg were produced in its five centuries of history until 1990 when production was reduced to a few hundred kilos per year. The average recovery rate of mercury has been estimated to 73%; much of the remaining 27% was dissipated into the environment. In spite of present minimal levels of production, and only a few days of smelter operation per year, a real time survey with a mercury Zeeman analyzer in a car showed relatively high mercury concentrations in the air. Amounts of 300–4000 ng Hg m⁻³ have been found around both the major sources of mercury vapor, the smelter and mine ventilation shaft – while the amounts at the Old Place, at the City Museum, and near the Nikova-Idrijca confluence are of the order of 50 ng/m⁻³. Polluted air will be transported from those sources to a degree, which depends on the weather conditions, mainly the direction and intensity of the wind. The high mercury contents in the air are not only due to anthropogenic sources (smelter and the ventilation shaft, dumps and smelter slag used in construction), but may also partly be natural as in the Pront area, where the outcropping bedrock contains native mercury.

Pogarev S. E., Ryzhov V. V., Mashyanov N. R., Sobolev M. B. **Mercury values in urine from inhabitants of St. Petersburg** // Water, Air and Soil Pollution. – 1997. – V. 97. – No. 1–2. – P. 193–198.

Abstract: The results of 3000 urine analyses are presented. The observational data were obtained for the reference group of school

children and adults and for groups of people suffered from indoor mercury pollution. A novel Zeeman atomic absorption spectrometer and cold vapor and pyrolysis methods were used for determination of total mercury. A background mercury value in urine for St. Petersburg region is determined as 0.5 µg/l. Distributions of mercury concentrations in urine after five accidents are given. There are considerable differences in total mercury distribution for each group, that depend on level of Hg exposure. Peculiar features of the 24-hour rhythm of mercury excretion with urine is used for the treatment of patients, an optimal therapy selection and rehabilitation control.

1998

Ryzhov V. V., Mashyanov N. R., Ozerova N. A. **The first registration of periodic mercury content variations in natural hydrocarbon gas** // Problems of Geophysics. – St. Petersburg Univ. ed. – 1998. – Issue 35. – P. 295–308. (*In Russian*).

Ganeev A. A., Sholupov S. E. **A thin-walled metallic hollow cathode as an atomizer for Zeeman atomic absorption spectrometry** // Spectrochimica Acta Part B: Atomic Spectroscopy. – 1998. – V. 53. – No. 3. – P. 471–486.

1999

Ozerova N. A., Mashyanov N. R., Pikovsky Yu. I., Ryzhov V. V., Chernova A. E., Ganeev A. A., Sholupov S. E., Dobryansky L. A. **Mercury in gas and oil deposits** // Mercury Contaminated Sites: Characterization, Risk Assessment and Remediation / Ed. by Ralf Ebinghaus, Ralph R. Turner, Luiz D. de Lacerda. – Berlin: Springer-Verlag, 1999. – P. 237–246.

2000

Spiric Z., Mashyanov N. R. **Mercury measurements in ambient air near natural gas processing facilities** // Fresenius Journal of Analytical Chemistry. – 2000. – Vol. 366. – No. 5. – P. 429–432.

Abstract: Natural gas from gas fields around the globe often contains mercury, along with a large number of other harmful substances (CO₂, H₂S, RSH, COS, etc). Mercury's potentially harmful effect on humans and on the ecological system as a whole as well as the technological risk regarding very sophisticated and expensive process equipment and catalysts make its removal imperative. There is a need for the highest efficiency for mercury removal and for permanent improvement and enhancement of technological and control procedures, including analytical instruments and measurements.

Mercury concentration measurements in the ambient air performed during natural gas processing confirm that the design of the system at the Molve gas plant is adequate to meet the mercury removal objectives. The obtained results also illustrate in an excellent way the use of the portable instrument to identify and prevent potential mercury generated hazards linked to specific industrial processes.

2001

Bin C., Xiaoru W., Lee F. S. C. **Pyrolysis coupled with atomic absorption spectrometry for the determination of mercury in Chinese medicinal materials** // Analytica Chimica Acta. – 2001. – V. 447. – No. 1–2. – P. 161–169.

Abstract: A pyrolysis unit was coupled to an atomic absorption spectrometer for the determination of mercury in solid samples of Chinese medicinal

materials (CMMs). This highly sensitive analytical technique provides a simple and rapid method for the screening of Hg in CMM samples including raw herbs, mineral drugs and their derived formulated products. Only 20 mg samples were needed and the sensitivity is down to 66 pg. The precisions of analyzing solid Hg standard samples and real CM samples were 1.9 and 3–7%, respectively. The recovery of the method was between 97.6 and 102.7% using Hg standard spiked certified reference material of Apple Leaves. No sample pre-treatment was needed and this greatly simplifies the analytical procedure and minimizes potential sources of contamination. Several CM samples were analyzed and the results obtained agreed well with the certified values. The performance of the method was compared with the widely used cold vapor and inductively coupled plasma–mass spectrometry (ICP-MS) methods. Excellent agreements were observed among these methods for Hg levels in the ng region. With the temperature programming capability of the pyrolysis chamber the instrument can potentially be used for the speciation analysis of Hg.

2002

Ryzhov V. V., Mashyanov N. R., Ozerova N. A., Pogarev S. E. **Regular variations of mercury content in natural gas** // Science of the Total Environment. – 2002. (*In press*).

Pogarev S. E., Ryzhov V., Mashyanov N., Sholupov S., Zharskaya V. **Direct measurement of the mercury content of exhaled air: a new approach for determination of the mercury dose received** // Analytical and Bioanalytical Chemistry. – 2002. – V. 374. – No. 6. – P. 1039–1044.

Abstract: A new rapid technique is presented for determination of the dose of mercury inhaled; it is based on direct measurement of the concentration of mercury in exhaled air by use of a Zeeman mercury spectrometer RA-915+. It has been demonstrated experimentally that the dose received during short-term exposure to mercury vapor is determined more reliably by this method rather than by conventional techniques based on measurement of the mercury content in blood or urine.

B: ABSTRACTS

1992

Ganeev A. A., Dreval T. V., Ilyin Yu. T., Mashyanov N. R., et al. **Mercury haloes in the marine atmosphere above tectonic structures and gas-hydrate deposits** // Abstr. International Symposium “Unconventional Hydrocarbons: Sources, Problems of Exploration and Production” (St. Petersburg, Russia, October 12–16, 1992). – V. 2. – P. 58–60.

Ozerova N. A., Mashyanov N. R., Ryzhov V. V., et al. **Naphthametallogeny of the mercury** // Abstr. International Symposium “Unconventional Hydrocarbons: Sources, Problems of Exploration and Production” (St. Petersburg, Russia, October 12–16, 1992). – V. 1. – P. 114–115.

1996

Altman E., Panichev N. **Determination of metal content of airborne particle matter by ETA-AAS – prospects and problems** // Proc. 2nd

European Furnace Symposium (St. Petersburg, Russia, May 26–30, 1996). – P. 18.

Altman E., Panichev N., Kvitko K. **Biotransformation of chemical forms of Cd by bacteria in polluted water reservoirs** // Joint Annual Meeting WINNIPEG-96 (Winnipeg, Canada, May 27–29, 1996). – P. 7.

Altman E., Panichev N., Turunov Yu. **Relation between variations metal content in expired air and diseases of human lungs** // Proc. 2nd International Symposium on Air Monitoring AIRMON-96 (Salen, Sweden, February 5–8, 1996). – P. 2.

Dreval T. V., Mashyanov N. R., Ryzhov V. V., Sholupov S. E., Reshetov V. V., Sobolev M. B., Vorms V. V. **Mercury in the atmosphere of St. Petersburg – distribution, origins and influence on human health** // Proc. 4th International Conference “Mercury as a Global Pollutant” (Hamburg, Germany, August 4–8, 1996). – P. 217.

Goltsova N. I., Pitulko V. M., Mashyanov N. R. **The role of mercury in impact pollution mechanisms on boreal forest** // Proc. 4th International Conference “Mercury as a Global Pollutant” (Hamburg, Germany, August 4–8, 1996). – P. 337.

Gosar M., Pirc S., Sajn R., Bidovec M., Mashyanov N. R., Sholupov S. E. **Mercury in the air: pollution in Idrija, Slovenia** // Proc. 4th International Conference “Mercury as a Global Pollutant” (Hamburg, Germany, August 4–8, 1996). – P. 468.

Miko S., Palinkaš L. A., Durn G., Mashyanov N. R., Sholupov S. E. **Geochemical prospecting for gold in the tributaries of the Mentebah and Tenangun rivers in Central Kalimantan, Indonesia** // Proc. International Conference on “Regularities of the Evolution of the Earth Crust” (St. Petersburg, Russia, October 15–18, 1996). – V.1. – P. 133.

Ozerova N. A., Chernova A. I., Mashyanov N. R., Ryzhov V. V., Sveshnikov G. B., Pikovsky Yu. I., Leontyev I. A., Dobryansky L.A., and Zherebtsov Yu. D. **Mercury in gas and oil deposits** // Proc. 4th International Conference “Mercury as a Global Pollutant” (Hamburg, Germany, August 4–8, 1996). – P. 336.

Ozerova N. A., Sveshnikov G. B., Mashyanov N. R., Ryzhov V. V., Sholupov S. E., Pogarev S. E., Ganeev A. A., Pikovskiy Yu. I. **New aspects in mercury geochemistry** // Proc. International Conference on “Regularities of the Evolution of the Earth Crust” (St. Petersburg, Russia, October 15–18, 1996). – V. 2. – P. 16.

Pogarev S. E., Ryzhov V. V., Dreval T. V., Mashyanov N. R. **Mercury values in urine from inhabitants of St. Petersburg** // Proc. 4th International Conference “Mercury as a Global Pollutant” (Hamburg, Germany, August 4–8, 1996). – P. 222.

Sholupov S. E., Ganeev A. A., Zhang J. **ATMOS HG – A new mercury spectrometer** // Proc. 4th International Conference “Mercury as a Global Pollutant” (Hamburg, Germany, August 4–8, 1996). – P. 48.

1997

Ganeev A. A., Slyandev M. N., Sholupov S. E. **Analytical features of Zeeman atomic absorption spectrometry using high frequency modulated light polarization with the discharge atomization** // Abstr. Beijing Conference on Instrumental Analysis BCEIA-97 (Shanghai, China, October 13–17, 1997). – P. N-53.

Ganeev A. A., Slyandev M. N., Sholupov S. E. **Thin-walled metallic hollow cathod as an atomizer for analytical atomic spectroscopy** // Abstr. Analytical Conference ASIA V (Fukuoka, Japan, May 3–5, 1997). – P. 103.

Muradov A. Yu., Sobolev M. B., Mashyanov N. R., Ryzhov V. V., Pogarev S. E. **Estimation of pathological reactions risk degree after short-term mercury vapour affect on the children** // Proc. Conference on Human Health Effects of Mercury Exposure (Tornshaven, Faroe Islands, June 22–26, 1997).

Sobolev M. B., Mashyanov N. R., Ryzhov V. V., Pogarev S. E. **Oxaluria as an indicator of tolerance for mercury vapour exposure** // Proc. Conference on Human Health Effects of Mercury Exposure (Tornshaven, Faroe Islands, June 22–26, 1997).

Spiric Z., Mashyanov N. R., Ryzhov V. V., Pogarev S. E. **Determination of low mercury concentrations in ambient air with portable mercury spectrometer – RA 915** // Proc. 1st Croatian Conference “Ambient Air Protection” (Crikvenica, Croatia, October 16–18, 1997). – P. 521–525.

1998

Ryzhov, V. V., Mashyanov, N. R., Ozerova, N. A. **Variations of mercury content in natural gas** // Proc. 5th Ukrainian International Oil and Gas Conference “Oil and Gas Ukraine-98” (Poltava, Ukraine, September 15–17, 1998). – V. 2. – P. 230.

1999

Mashyanov N. R., Ryzhov V. V., Reshetov V. V. **Origins of mercury pollution in St. Petersburg region** // Proc. 5th International Conference “Mercury as a Global Pollutant” (Rio de Janeiro, Brazil, May 23–27, 1999). – P. 550.

Ozerova N. A., Chernova A. E., Mashyanov N. R., Antipov A. B. **Mercury in the ore-bearing newly formed deposits of the world ocean** // Proc. 5th International Conference “Mercury as a Global Pollutant” (Rio de Janeiro, Brazil, May 1999). – P. 179.

Ryzhov V. V., Mashyanov N. R., Ozerova N. A., Pogarev S. E. **Regular variations of mercury contents in natural hydrocarbon gas** // Proc. 5th International Conference “Mercury as a Global Pollutant” (Rio de Janeiro, Brazil, May 23–27, 1999). – 180.

Sholupov S. E., Ganeev A. A., Pogarev S. E., Ryzhov V. V. **Thermospectrometry of mercury organic and inorganic**

species // Proc. 5th International Conference "Mercury as a Global Pollutant" (Rio de Janeiro, Brazil, May 23–27, 1999). – P. 20.

Sholupov S. E., Ganeev A. A., Ryzhov V. V., Pogarev S. E., Stroganov A. A. **RA-915 – a novel portable Zeeman atomic absorption spectrometer for determination of low levels of mercury in air and complex matrix samples** // Proc. 5th International Conference "Mercury as a Global Pollutant" (Rio de Janeiro, Brazil, May 23–27, 1999). – 40.

Spiric Z., Dragas M., Vadunec J., Mashyanov N. R., Ozerova N. A. **Investigation of mercury content in Podravina gas fields and environment** // Proc. 6th International Petroleum Environmental Conference (Houston, USA, November 16–19, 1999).

Spiric Z., Mashyanov N. R. **Mercury measurements in ambient air during natural gas production with portable Zeeman mercury spectrometer – RA 915** // Proc. 5th International Conference "Mercury as a Global Pollutant" (Rio de Janeiro, Brazil, May 23–27, 1999). – P. 12.

2000

Ozerova N. A., Antipov A. B., Mashyanov N. R. **Hg degasation within the Kamchatka-Pacific frontier region** // Proc. 3rd Workshop on Land Ocean Interactions in the Russian Arctic (LOIRA) devoted to 100-th anniversary of G. A. Ushakov (Moscow, Russia, December 5–8, 2000). – P. 110–111.

Ozerova N. A., Mashyanov N. R. **Mercury ecogeochemistry – a prediction base of mercury hazard caused by natural resources processing** // Proc. 25-th Silver Anniversary International Conference on Heavy Metals in the Environment (Ann Arbor, Michigan, USA, August 6–10, 2000).

2001

Mashyanov N. R., Ozerova N. A., Ryzhov V. V. **Resources of mercury in gas deposits as related to its spatio-temporal variability in hydrocarbon gases** // Proc. 6th International Conference "Mercury as a Global Pollutant" (Minamata, Japan, October 15–19, 2001). – P.58.

Mashyanov N. R., Sholupov S. E., Ryzhov V. V., et al. **Detection of pollution sources using continuous mercury automobile survey** // Proc. 6th International Conference "Mercury as a Global Pollutant" (Minamata, Japan, October 15–19, 2001). – P.58.

Ozerova N. A., Mashyanov N. R. **Mercury ecologeochemistry** // Proc. 6th International Conference "Mercury as a Global Pollutant" (Minamata, Japan, October 15–19, 2001). – P. 140.

Pogarev S. E., Ryzhov V. V., Sholupov S. E., Zharskaya V. D. **Mercury in the exhaled air, blood and urine among persons exposed to elemental mercury** // Proc. 6th International Conference "Mercury as a Global Pollutant" (Minamata, Japan, October 15–19, 2001). – P.79.

Ryzhov V. V., Mashyanov N. R., Pogarev S. E., Ozerova N. A. **Short-term variability of the mercury content in hydrocarbon gases as an indicator of dynamic processes in the lithosphere** // Proc. 6th International Conference "Mercury as a Global Pollutant" (Minamata, Japan, October 15–19, 2001). – P.145.

Sholupov S. E., Markelov M., Siperstein J. **Effect of external conditions (air temperature and pressure) on the determination of mercury content in ambient air** // Proc. 6th International Conference "Mercury as a Global Pollutant" (Minamata, Japan, October 15–19, 2001). – P.49.

Sholupov S., Markelov M., Siperstein J., Dechant D. **Rapid screening of solid samples for mercury using pyrolysis option with portable RA-915 mercury analyzer with Zeeman correction** // Proc. Pittsburg Conference on Analytical Chemistry and Spectroscopy PittCon'2001 (New Orleans, USA, March 4–9, 2001).

Sholupov S. E., Pogarev S. E., Ryzhov V. V., Christensen I. **The determination of ultra-trace (ppt) mercury content by the CV AAS without preconcentration** // Proc. 6th International Conference "Mercury as a Global Pollutant" (Minamata, Japan, October 15–19, 2001). – P.84.

Sholupov S. E., Popov A. P., Ryzhov V. V., Pogarev S. E., Markelov M., Siperstein J. **New real-time Zeeman atomic absorption continuous mercury (HG) emission monitor** // Proc. 6th International Conference "Mercury as a Global Pollutant" (Minamata, Japan, October 15–19, 2001). – P.83.

Sholupov S. E., Ryzhov V., Popov A., Siperstein J. **New real-time Zeeman atomic absorption continuous mercury emission monitor** // Proc. International Conference on Emission Monitoring (Arnhem, The Netherlands, 25–27 April, 2001).

2002

Altman E. L., Panichev N. A. **Gold in the atmospheric air as an indicator of deep gold deposit** // Proc. South African Chemical Conference SACI 2002 (Port Elisabeth, SAR, July 1–5, 2002). – P. 45–47.

Higuera P., Segador M. M., Ryzhov V., Mashyanov N., Benitez A. **Mercury vapour content in the air at the Almadén mercury mining district, Spain** // Proc. 18th General Meeting of the International Mineralogical Association (Edinburgh, Scotland, September 1–6, 2002).

Mashyanov N. **Are the regular variations of mercury in hydrocarbon gas a possible predictor of earthquakes?** // Atomic seminar at Department of Physics, University of California (Berkeley, USA, March 28, 2002).

Mashyanov N. R. **Mercury in the environment. Problems of mercury pollution control** // Workshop on Environmental Monitoring. University of Kuopio, (Kuopio, Finland, October 18, 2002).

Pogarev S.; Ryzhov V., Mashyanov N., Sholupov S. **Direct and high selectively measurement of mercury concentration in the exhaled air – the only reliable method for determination of Hg vapor exposure** // Proc. Air Quality III – International Conference on Mercury, Trace Elements, and Particulate Matter (Arlington, VA, September 9–12, 2002). – P. 343.

Pogarev S., Ryzhov V., Sholupov S., Mashyanov N., Zharskaya V. **New rapid method for determination of mercury dose by measuring Hg concentration in the exhaled air** // Proc. 18th Nordic Conference on the Measurement of Elements and their Compounds (NASTEC) (Naantali, Finland, August 18–21, 2002). – P. 52.

Ryzhov V. V., Sholupov S. E., Mashyanov N. R., Markelov M., Siperstein J. **Calibration of mercury analyzers and dynamic vapor generators** // Proc. Pittsburg Conference on Analytical Chemistry and Spectroscopy PittCon'2002 (New Orleans, USA, March 18–22, 2002). – P. 150.

Ryzhov V., Sholupov S., Pogarev S., Christensen I. **Direct AA mercury determination in samples with complex matrix** // Proc. 18th Nordic Conference on the Measurement of Elements and their Compounds (NASTEC) (Naantali, Finland, August 18– 21, 2002). – P. 35.

Sholupov S. E., Ganeev A. A. Pogarev S. E., Ryzhov V. V. Christensen I. **Determination of ultra-trace (ppt) mercury content in water without preconcentration** // Proc. Pittsburg Conference on Analytical Chemistry and Spectroscopy PittCon'2002 (New Orleans, USA, March 18–22, 2002). – P. 144.

Sholupov S.E., Markelov M., Siperstein J. **Effect of external conditions (air temperature and pressure) on the determination of mercury in atmosphere** // Proc. Pittsburg Conference on Analytical Chemistry and Spectroscopy PittCon'2002 (New Orleans, USA, March 18–22, 2002). – P. 717.

Sholupov S., Pogarev S., Ryzhov V. **Modification of Method 6009 NIOSH on determination of average mercury concentration in the air** // Proc. Air Quality III – International Conference on Mercury, Trace Elements, and Particulate Matter (Arlington, VA, September 9–12, 2002). – P. 355.

Sholupov S., Pogarev S., Ryzhov V., Ganeev A., Mashyanov N., Stroganov A. **New mobile Zeeman mercury spectrometer – an air real time mercury tracer** // Proc. Air Quality III – International Conference on Mercury, Trace Elements, and Particulate Matter (Arlington, VA, September 9–12, 2002). – P. 356.

Sholupov S., Pogarev S., Ryzhov V., Mashyanov N., Stroganov A. **New portable Zeeman atomic absorption mercury spectrometer** // Proc. 18th Nordic Conference on the Measurement of Elements and their Compounds (NASTEC) (Naantali, Finland, August 18–21, 2002). – P. 59.

Sholupov S. E., Pogarev S. E., Ryzhov V. V., Mashyanov N. R., Stroganov A. A., Higuera P., Spiric Z. **RA-915 – new mobile Zeeman mercury tracer** // Proc. International Workshop on Health and Environmental Effects of Mercury in Africa (Dar es Salaam, Tanzania, November 19–22, 2002).

Stroganov A., Sholupov S., Pogarev S., Ryzhov V., Mashyanov N. **Enhancement of efficiency of mercury remediation by application of a real time mercury spectrometer RA-915⁺** // Proc. Air Quality III. International Conference on Mercury, Trace Elements, and Particulate Matter (Arlington, VA, September 9–12, 2002). – P. 352.