



*Thematic section:* Physical and Chemical Research.

*Subsection:* Inorganic Technology.

**Full Paper**

*The Reference Object Identifier* – ROI-jbc-B/21-1-1-14

*The Digital Object Identifier* – DOI: 10.37952/ROI-jbc-B/21-1-1-14

Received 20 April 2021; Accepted 22 April 2021

## **Investigation of the chemical and phase composition of the carbon deposits of small arms on the example of the VSS rifle and the AK-200**

**Mikhail G. Ivanov,\*<sup>+</sup> Evgenia A. Nikonenko, and Denis M. Ivanov**

*Department of General Chemistry. Ural Federal University the First President  
of Russia B.N. Yeltsin. Mira St., 19. Yekaterinburg, 620002. Russia.*

*Phone: +7 (343) 375-93-87. E-mail: m.g.ivanov@urfu.ru*

\*Supervising author; <sup>+</sup>Corresponding author

**Keywords:** small arms, shot products, X-ray phase analysis, chemical analysis.

### **Abstract**

The development of effective chemical care products for automatic small arms involves the study of the X-ray phase and chemical composition of carbon deposits that form as a result of a shot. At the same time, there is a possibility that different types of firearms, depending on the composition of the primers, the conditions of combustion of the powder and the design features of the weapon, can lead to the formation of various carbon particles with different internal morphology and composition. First of all, this concerns silent weapons with subsonic bullet velocities.

Using the methods of X-ray phase and chemical analyzes, the material composition of the soot on the AK-200 and the VSS «Vintorez» silent sniper rifle was studied. The structure and elemental composition of the deposit are estimated, the features of the interphase distribution of elements are revealed.

According to X-ray data, the main chemical compounds of AK-200 soot are oxides of copper, lead, tin, as well as potassium tetrathionate. At the same time, the composition of the BCC rifle soot is mainly represented by lead compounds in the form of oxide, dioxide and carbonate. The water-soluble salt in BCC carbon is sodium chloride.

Based on the data obtained, the chemical and phase composition is of fundamental importance for the creation of water means for removing carbon deposits from the integrated muffler of the VSS and AK-200 complex. The presence of water-soluble salts (KCl, K<sub>2</sub>S<sub>4</sub>O<sub>6</sub>) in both deposits necessitates the use of inhibited oils after cleaning the weapon.

**For citation:** Mikhail G. Ivanov, Evgenia A. Nikonenko, Denis M. Ivanov.

Investigation of the chemical and phase composition of the carbon deposits of small

arms on the example of the VSS rifle and the AK-200. *Butlerov Communications B.* **2021**. Vol.1. No.1. Id.18. DOI: 10.37952/ROI-jbc-B/21-1-1-14

## References

- [1] J.I. Thornton. The chemistry of death by gunshot. *Anal. Chim. Acta.* **1994**. Vol.288. P.71-81.
- [2] Kara, Ilker, Y. Sarikavak, S.B. Lisesivdin, & M. Kasap. Evaluation of morphological and chemical differences of gunshot residues in different ammunitions using SEM/EDS technique. *Environmental Forensics.* **2016**. Vol.17. No.1. P.68-79.
- [3] Francesco Saverio, Romolo Pierre Margot. Identification of gunshot residue: a critical review. *Forensic Science Int.* **2001**. Vol.119. No.2. P.195-211.
- [4] M. Tassa, Y. Leist, M. Steinberg. Characterization of gunshot residues by X-ray diffraction. *J. Forensic Sci.* **1982**. Vol.27. P.677-683.
- [5] F.K. Babak. The basics of small arms. *SPb. Polygon Publishing House.* **2003**. 253p. (Russian)
- [6] A.V. Shabrov, V.G. Dzhangiryan, D.V. Fadeev, V.N. Ageev, G.R. Fadeeva. Optimization of technological parameters of the production process of equipping primer-igniters with the use of shock-igniting compositions in a pasty state. *Bulletin of Kazan Technological University.* **2016**. Vol.16. No.19. P.145-147. (Russian)
- [7] Rainer Heigel, Klaus H. Redecker, Waldemar Weiter. Primer Compositions in the Course of Time: From black powder and SINOXID to SINTOX compositions and SINCO booster. *Propellants, Explosives, Pyrotechnics.* **1996**. Vol.21. P.113-117. Rainer Heigel, Klaus H. Redecker, Waldemar Weiter. Primer Compositions in the Course of Time: From black powder and SINOXID to SINTOX compositions and SINCO booster. *Propellants, Explosives, Pyrotechnics.* **1996**. Vol.21. P.113-117.
- [8] Yu.M. Baskakov, V.P. Korolev, A.E. Fogelzang et al., Pyrotechnic impact igniter for rimfire cartridges. *Patent RU 2144523*, publ. 20.01.2000 Bul. No.2. (Russian)
- [9] R.Z. Gilmanov, I.F. Falyakhov, A.I. Sudakova and other. Incendiary non-rusting impact composition. *Patent RU 2317966*, publ. February 27, **2008**. Bul. No.6. (Russian)
- [10] S. Basu. Formation of gunshot residues. *J. Forensic Sci.* **1982**. Vol.27. No.1. P.72-91.
- [11] D.V. Korotaev, A.V. Erokhin, S.A. Semeguk, V.V. Rakov. About shot products and experienced maintenance of the AK 74M assault rifle. *Bulletin of TulSU. Technical science.* **2019**. Iss.6. P.77-89. (Russian)
- [12] A.A. Potapov. Sniper art. *Mir: Grand: "Fair-Press"*. **2005**. 543p. (Russian)
- [13] Mikhail G. Ivanov, Evgenia A. Nikonenko, Denis M. Ivanov. Investigation of the chemical and phase composition of the carbon deposits of small arms on the example of the VSS rifle and the AK-200. *Butlerov Communications.* **2021**. Vol.66. No.5. P.83-88. DOI: 10.37952/ROI-jbc-B/21-66-5-83