

## ANALYSIS OF MICRO AND MACRO ANALYSIS OF METALS AND ALLOYS

**Atakhonova Sayyora Koraboyevna**

Associate Professor, Andijan State technical institute

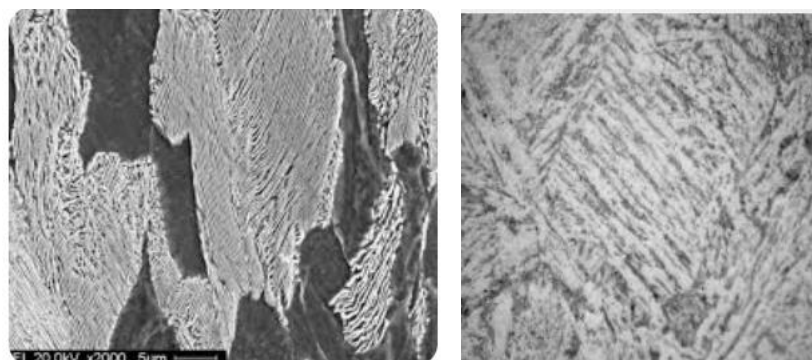
Email: ataxonova.sayyora@mail.ru

**ABSTRACT:** Analyzing the micro and macro structure of metals and their alloys is one of the essential scientific processes, helping determine their structure, chemical composition, and physical properties. This study presents microscopic and macroscopic analysis methods, their application areas, and results.

**Key words:** analysis, metals, optical microscopy, technology.

### 1. Introduction

Metals and alloys are of great importance in industry, technology, and scientific research. The metallurgy industry, mechanical engineering, aviation, and astronautics widely utilize various metals and their alloys. Their mechanical and physical properties, chemical composition, and processing characteristics are the primary objects of research. Micro and macro analysis methods play a crucial role in determining and controlling the quality and properties of metals and alloys. Microanalysis allows the study of the microscopic structure of metals and the identification of structural changes.



**Figure 1. Ferrite**

Macroanalysis helps study the overall structure of materials, deformation processes, and internal and external defects.

The main microanalysis methods include:

**Optical microscopy** – enables the study of metal microstructures, grain structure, and phase composition.

**Electron microscopy** – helps determine the arrangement and bonding of elements by obtaining high-resolution images.

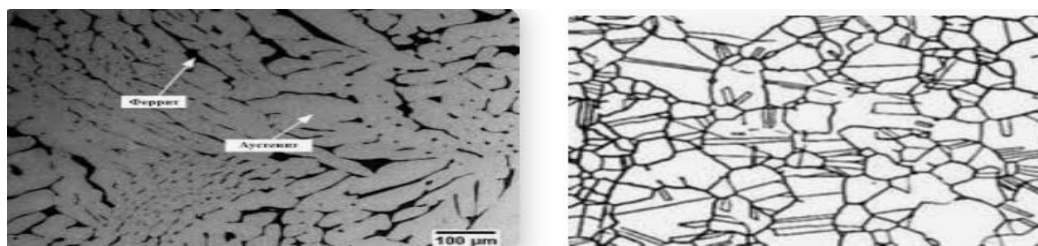
**X-ray spectral analysis** – used to determine the chemical composition of metals and alloys.

Macroanalysis primarily relies on the following methods:

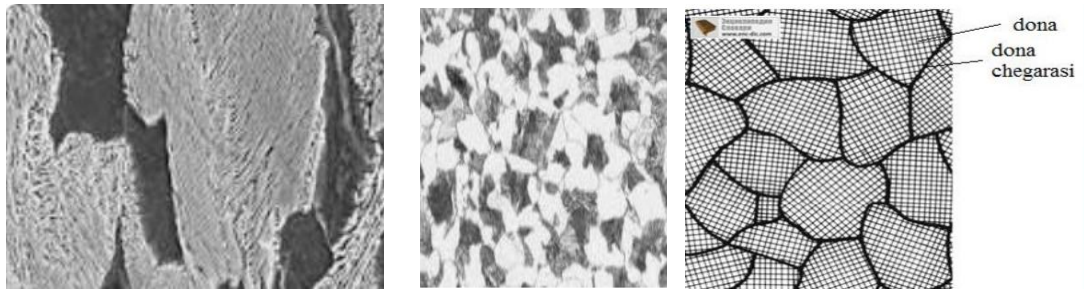
**Visual inspection** – identifies defects and irregularities on the material surface.

**Chemical analysis** – determines the primary elements in metals.

**Thermal analysis** – evaluates the thermal stability and heat resistance of metals and alloys.



**Figure 2. Austenite**



**Figure 3. Pearlite**

Based on the results of micro and macroanalysis, it is possible to optimize the processes of production, processing, and use of metals and alloys. Additionally, these analyses help ensure product quality and reliability, complying with industrial standards. This process is particularly important in aviation, the automotive industry, construction materials, and electrical engineering. Based on the results, the extensive application of micro and macro analysis methods plays a significant role in developing new materials in metallurgy, improving their properties, and advancing innovative technologies.

## **2. Research methods**

Microanalysis is used to determine the internal structure of materials. The following aspects are studied through this method:

**Metallographic analysis** – studying microstructure using optical and electron microscopes.

**Spectroscopic analysis** – determining the elemental composition of materials.

**X-ray spectral analysis** – analyzing the distribution of structural elements.

Macroanalysis. Macroanalysis is used to determine the overall structure and surface defects of materials. The primary methods include:

**Visual inspection** – identifying defects.

**Chemical analysis** – studying the primary composition of the substance.

**Thermal analysis** – testing heat resistance and phase transformations.

### 3. Results and analysis

The following table presents comparative results of micro and macro analysis methods:

Analysis Method	Advantages	Disadvantages
Optical Microscopy	Inexpensive and quick results	Low resolution
Electron Microscopy	High resolution	Expensive and complex technology
X-ray Spectral Analysis	Identifies elemental composition	Requires a specialized laboratory
Chemical Analysis	Determines exact composition	Time-consuming

The following diagram compares the results of micro and macro analysis:

### 4. Conclusion

The micro and macro analysis of metals and alloys is a crucial scientific and technological process that allows assessing the composition and quality of materials. The research results indicate that both types of analysis have specific advantages and limitations, and their combined application provides the most effective results.

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