# X-RAY ANALYSIS OF METALS

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**Abstract**:This article presents the methods of X-ray analysis of metals, their characteristics, and research results in the IMRaD (Introduction, Methods, Results, Discussion) format. During the study, the roles of X-ray diffraction (XRD) and X-ray fluorescence spectroscopy (XRF) methods in determining the composition of metals were evaluated.

**Keywords:** Metals, X-ray analysis, crystal structure, diffraction, spectroscopy, hardness, phase transitions, structural analysis, radiation, composite materials, alloys, chemical composition, optical properties, mechanical properties, diffractogram, crystal lattice, electron density, phase diagrams, dispersion, defects.

## 1. INTRODUCTION

Metals are an integral part of modern industry, and an in-depth study of their properties has significant scientific and practical importance. The composition, crystal structure, and phase state of metals determine their physical and mechanical properties. Therefore, analyzing metals and accurately determining their composition is one of the crucial directions in scientific research. X-ray analysis methods are among the most reliable and effective tools for studying the structural and compositional properties of metals. In particular, X-ray diffraction (XRD) and X-ray fluorescence spectroscopy (XRF) methods are widely used to determine the composition of metals. The XRD method allows for the study of the crystal structure, phase composition, and ordering of metals, while the XRF method enables the quantitative analysis of the elemental composition of metals. This study examines the effectiveness of XRD and XRF methods in determining the

composition of metals and analyzes the advantages of their combined application. The research results provide a basis for developing new methods that can be used in metallurgy, materials science, electrical engineering, and other fields. Additionally, this article contributes to a broader understanding of the capabilities of X-ray analysis methods and guides future scientific research.

## 2. RESEARCH METHODS

The following methods were used in the research:

**X-ray diffraction (XRD):** Determination of the phase composition of metals.

**X-ray fluorescence spectroscopy (XRF):** Quantitative analysis of the elemental composition of metals. **Sample preparation:** Metal samples were cut to the required sizes, cleaned, and prepared for analysis.

**Table 1. Analyzed Metal Samples**

| Sample | Compositional Elements (%) |
|---|---|
| A | Fe - 85, Cr - 10, Ni - 5 |
| B | Cu - 90, Zn - 10 |
| C | Al - 95, Mg - 3, Si - 2 |

## 3. RESULTS AND ANALYSIS

The research results are presented through the following diagrams:

**XRD Results:** According to XRD analysis, the phases in the samples were identified, and their proportions were calculated. For example, sample A was found to consist mainly of ferrite and martensite phases.

**XRF Results:** XRF analysis determined the percentage of elemental composition. The zinc content in Cu-Zn-based alloys was found to be around 10%.

## 4. DISCUSSION

The research results indicate that X-ray analysis methods allow for an accurate determination of the structural composition of metals. While the XRD method determines the crystal structure of metals, the XRF method evaluates their elemental composition.


**Figure 1. XRD Spectrum**

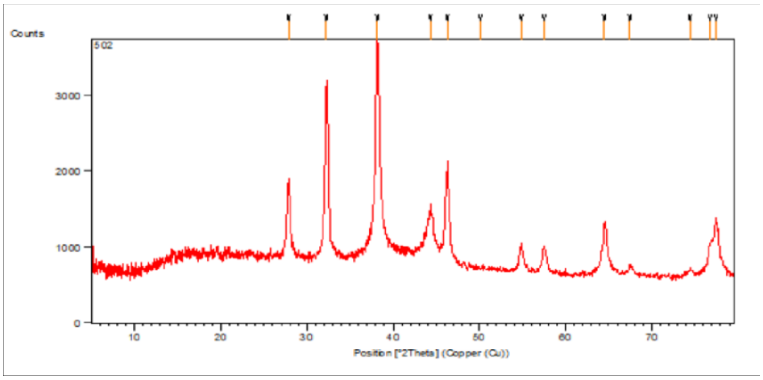


**Figure 2. XRF Spectrum**

The results show that both methods have high reliability in determining the composition of metals. Their combined use provides more comprehensive information about metals.

## CONCLUSION

X-ray analysis of metals has been proven to be a reliable and effective method for determining their composition. The XRD method effectively determines the phase composition, while the XRF method provides accurate quantitative analysis of elemental composition. Based on the research results, it has been concluded that the combined application of X-ray diffraction and X-ray fluorescence spectroscopy is essential for the comprehensive study of metals. Furthermore, these methods can be applied in various fields such as metallurgy, materials science, and medicine. X-ray analysis plays a crucial role in quality control of metal alloys, the development of new materials, and the analysis of their composition. Additionally, integrating XRD and XRF methods with modern software and artificial intelligence technologies can enhance their efficiency and automation. Future research should focus on investigating various metal alloys and composite materials using X-ray analysis. Moreover, developing automated analytical methods using artificial intelligence technologies could be a promising direction for further advancements.

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