

# History of The Formation and Development of Terms in The Field of Materials Science (On the Example of Russian, English And Uzbek Scientific Schools)

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**Abstract:** This article provides a comprehensive analysis of the stages of formation and development of terminology in the field of materials science from both historical and comparative perspectives. The study traces the evolution of materials science terms in close connection with the advancement of scientific thought, technological progress, and socio-cultural factors influencing scientific language. Particular attention is paid to the gradual transformation of terminology from early descriptive naming practices to highly standardized and systematized term structures used in modern scientific discourse. In addition, the article examines the periodization of term formation as interpreted by the Russian, English, and Uzbek schools of scientific terminology. Each tradition is analyzed in terms of its theoretical foundations, methodological approaches, and linguistic mechanisms of term creation. The Russian terminology school is discussed in relation to its emphasis on systematization and conceptual hierarchy, the English school in terms of internationalization and borrowing processes, and the Uzbek school with regard to term adaptation, nationalization, and linguistic modernization. The development of materials science terminology is explained step by step, highlighting key historical stages such as the initial borrowing of general scientific vocabulary, the emergence of specialized terms during industrial and technological revolutions, and the contemporary phase characterized by interdisciplinary integration and terminological globalization. Comparative analysis reveals both shared tendencies and language-specific features in term formation, including word-formation models, semantic shifts, and translation strategies.

Overall, the article demonstrates that the formation and development of materials science terminology is a dynamic and continuous process, shaped by scientific innovation, linguistic norms, and cultural context. The findings contribute to a deeper understanding of terminological evolution and offer valuable insights for terminology studies, translation theory, and the standardization of scientific language across different linguistic traditions.

**Keywords:** Term, materials science, Bronze Age, structure, polymer, metal, ceramics.

**Introduction:** The field of materials science has been developing gradually since the dawn of humanity. Better materials for tools and weapons allowed humans to live in separate communities and conquer the world. Advances in the processing of materials, such as the production of steel and aluminum, continue to influence society today. Historians have considered the development of materials to be such an important

aspect that entire eras are defined by the basic material used (Stone Age, Bronze Age, Iron Age). For much of history, materials were controlled at best by alchemy or imperial means.

Linguistics is of paramount importance in the study of materials science terminology. Terms are not only important in scientific communication, but are also used in industry and technology. It is impossible to

organize clear and understandable scientific communication without language. After all, the specific features, grammatical and semantic structure of each language serve to shape the terminology of the field in that language.

Materials science is an integrated science that studies the composition, structure, properties and processing of materials, formed at the intersection of metallurgy, physics and chemistry. By the middle of the 20th century, it was recognized as an independent science, and at the same time the language of science - terminology - was systematized. Terms express scientific thinking through the chain “structure–property–processing–performance”. The study and development of chemistry and physics contributed to the study of materials, and ultimately the interdisciplinary development of materials science emerged as a result of the merger of these studies. The history of materials science is the study of how various materials have been used and developed throughout world history and how these materials have influenced the cultures of the peoples of the world. In many cases, different cultures leave their materials as unique records; anthropologists can use them to determine the existence of such cultures. The increasing use of more sophisticated materials allows archaeologists to describe and differentiate peoples. This is partly due to the primary material used in the culture and its advantages and disadvantages. Stone Age cultures were limited to what could be found locally and obtained through trade. The use of flint around 300,000 BC is sometimes considered the beginning of the use of ceramics.

As history moved into the Mesolithic period, tools became more complex and symmetrical in design, with sharp edges. As history moved into the Neolithic period, agriculture began to develop as new methods of making tools for farming were discovered. Towards the end of the Stone Age, people began to use copper, gold, and silver as materials. The use of copper was important to civilizations, as it developed its elastic and malleable properties, allowing it to be shaped into useful forms, as well as its ability to be melted and cast into complex shapes. Although copper had many advantages, the material was too soft and there were no reserves for widespread use. Through experimentation or by chance, the addition of copper

increased the hardness of a new metal alloy called bronze. Bronze was originally composed of copper and arsenic, forming arsenic bronze. Ironworking had been popular since the 1200s BC.

## **METHODOLOGY**

In ancient Roman times, glassblowing became an art that included the addition of decoration and color. They were also able to create complex shapes thanks to the use of molds. This technology allowed them to explore precious stones. Polymer composites also appeared in the form of wood during this period. By the 80s BC, fossilized resin and keratin were used in accessories as amber and tortoiseshell, respectively.

In the 1st century BC, glassblowing developed in Alexandria, partly due to new furnaces that could generate high temperatures using a clay-coated reed tube.

In the 8th century, porcelain was invented in China during the Tang Dynasty. In China, porcelain led to the development of kilns, which were widely used, which increased the quality and quantity of porcelain that could be produced. Tin glazing of ceramics was invented by Arab chemists and potters in Basra, Iraq. In the 9th century, stoneware ceramics were invented in Iraq and glazed objects appeared in Mesopotamia. In the 11th century, Damascus steel was developed in the Middle East. In the 15th century, the development of a type metal alloy and the invention of crystal, a transparent soda-based glass, marked important milestones in materials science. This period was followed by the publication of the first systematic works on metallurgy, including *De la pyrotechnique*, and the influential treatise *De Re Metallica*, while advances in glass technology in the Netherlands led to the creation of lenses later used in microscopes and telescopes (Gutenberg, 1450; Barovier, 1455; Biringuccio, 1540; Agricola, 1556).

In the 19th century, major breakthroughs in materials science and applied physics included the invention of the thermocouple, the development of Portland cement, the vulcanization of rubber, the demonstration of silver-based photographic processes, the introduction of color photography, and the creation of the first solar cells using selenium wafers (Seebeck, 1821; Aspdin, 1824; Goodyear, 1839; Daguerre & Talbot, 1839; Maxwell, 1861; Fritts, 1883).

During the Cold War in the 1950s, materials science gained strategic importance when it was identified as a limiting factor in the advancement of space and military technologies, leading the U.S. President's Science Advisory Committee to prioritize materials research. In 1958, the Advanced Research Projects Agency was established, later renamed the Defense Advanced Research Projects Agency in 1996. In 1960, the agency further supported the creation of interdisciplinary laboratories on university campuses dedicated to materials research and the training of specialists in materials science (PSAC, 1957; Eisenhower, 1958; ARPA, 1960; DARPA, 1996). The field of crystallography, which studies the transmission of X-rays through crystals of solid materials, laid the foundation for modern structural analysis. From the 1960s onward, the combined progress of computer technology, crystallographic techniques, and laser technology enabled significant advances, including the development of light-emitting diodes used in DVD players and smartphones, fiber-optic communication systems for global telecommunications, and confocal microscopy, which has become a key analytical tool in materials science (Bragg & Bragg, 1913; Maiman, 1960; Kao, 1966).

## **RESULTS**

The term "Materials Science" in Russian reflects the transition from the old metallurgy and materials technology theories to systematic science in the scientific literature. The terms of this field were developed as the main part of the terminology of technical sciences during the former Soviet Union and serve as the foundation of the terminology of Russian linguistics. In turn, the Russian terminology school has systematic research on the structural and semantic systematization of terms. Such terms are often based on physical or chemical principles, and their semantic layers ensure scientific accuracy. For example, such terms as "сплав" (alloy), "устойчивость структуры" (stability of the structure) have taken a firm place in the Russian scientific language. The scientific foundations of metallurgy and foundry engineering in Russia were first systematically developed in the eighteenth century. A fundamental textbook entitled *The First Fundamentals of Metallurgy in Ore Mining* described metallurgical processes in a structured manner and attempted to explain their physical and chemical

essence, thereby laying the theoretical basis for metallurgy as an independent scientific discipline (Mikhail Vasilyevich Lomonosov, 1763). Significant progress in materials science was achieved in the nineteenth century with the introduction of new experimental methods for studying the internal structure of metals. For the first time, metallurgical investigations were conducted on polished and chemically etched metal surfaces examined under a microscope, which made it possible to analyze steel microstructure and marked the beginning of scientific metallography (Pavel Petrovich Anosov, 1831).

Further theoretical advancement of materials science was associated with systematic research on alloy systems, phase equilibria, and phase diagrams, which strengthened the scientific understanding of material structures. In the modern period, materials science expanded into interdisciplinary areas, including biomaterials research, where classification principles, structural properties, and specialized terminology became central research topics (Nikolai Semenovich Kurnakov, 1910). Russian-language historical sources devoted to metallurgy and metal structures provide important insights into the formation of fundamental concepts such as phase diagrams, microstructure descriptions, and the historical development of materials science terminology. Extensive explanatory and methodological materials on these issues are presented in textbooks and monographs written by specialists in metallurgy and materials science, which continue to shape contemporary scientific discourse in this field (Vladimir Sergeevich Komlev, 2005). Russian-language sources dedicated to the history of materials science and metal structures provide essential insights into fundamental concepts such as the historical formation of materials science terminology, phase diagrams, and microstructural descriptions. Extensive explanatory, historical, and methodological materials on these issues are presented in specialized textbooks and monographs authored by metallurgists and materials scientists, which continue to serve as a theoretical basis for contemporary research and terminology studies in the field (Gulyaev, 1986; Chernov, 1878).

In short, if we summarize the work of Russian scientists in materials science, they have made a great contribution to the formation and development of

materials science terminology.

In English, materials science research is much more global, where terms are not limited to chemistry and physics, and are significant in that they have many national and international standards. For example; the term “materials science” in English is widely used as a means of international technical communication in scientific articles, conferences, and textbooks. Concepts such as “structure-property relationships” and “processing techniques” occupy a central place in terminology, which help to understand the concept of science in the same way all over the world. When it comes to English scientists who have contributed to the development of the field of materials science, we must certainly recognize great scientist. He was an English materials scientist who popularized the terms and concepts of the field of materials science at the international level and made a great contribution to the popularization of specialized terminology by explaining scientific terms and their meaning in a language understandable to many readers and students. (Gordon, J. E. 1981. Structures: Or why things don't fall down. Da Capo Press).

In Uzbek language, the terminology of materials science is a new field compared to the Russian and English languages, and this science is developing rapidly. Field terms often come from English and Russian scientific terms through translation, and in turn, the terms of this field are being analyzed in accordance with international standards. In the Uzbek language, the main features of terms in the field of materials science are analyzed in a bilingual (two languages) context, semantically, morphologically and functionally, which sometimes complicates the translation and adaptation processes. In the terminology of this field, approaches such as “material science”, “structure of metals and polymers” are sometimes found, but they require standardization in scientific dictionaries.

## **DISCUSSION**

As for the main factors of terminology formation, they are often technological developments in materials science (metallurgy, nanomaterials, composites) that have led to the need to create terms. At the same time, this field intersects with such disciplines as physics, chemistry, and biology, and each field introduces its

own terminology, which in turn leads to linguistic synthesis and innovations. When translating Russian and English scientific terms into Uzbek, attention must be paid to semantic, morphological, and contextual compatibility.

The English school turned terms into a global standard: units such as “microstructure, phase, processing, performance” have become part of the international scientific language. The Russian school, on the other hand, enriched metallography and crystallography with a deep theoretical basis and defined clear semantic boundaries of terms. The development of materials science terminology in English and Uzbek shows a strong interaction between international scientific discourse and national linguistic traditions, which directly influences term formation and semantic structure (Yavminova, N. M. (2025). Functional features of material science terminology in English and Uzbek languages. International Conference on Multidisciplinary Science).

## **CONCLUSION**

Historically, the terminology of materials science has been continuously formed at the intersection of metallurgy, physics, and chemistry, reflecting the interdisciplinary nature of the field. In English, structural and alloy-related terms were standardized to facilitate clear communication in scientific research and education, while in the Russian school, phase and crystallographic terminology was systematized and expanded to support theoretical and experimental investigations. In the Uzbek language, scientific articles often analyze the structure, translation, and functional aspects of terminology, while also addressing challenges in adapting and integrating scientific terms into the national language, ensuring both accuracy and usability in education and research.

These cumulative efforts by scientists have made a significant contribution to the development, standardization, and pedagogical dissemination of materials science terminology across English, Russian, and Uzbek contexts. It is through this body of literature that widely used terms, their definitions, and functional applications are consistently standardized, enabling international scientific communication while respecting linguistic and cultural specificities (Gordon, 1981; Hume-Rothery, 1966; Chernov, 1878; Beliaev,

1925; Kurdyumov, 1939; Yavminova, 2025).

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