

# Technical English for Materials Science

## A Comprehensive Reference Guide

### 1. Core Vocabulary & Terminology

#### Material Classification

Term	Definition
Metals	Materials with metallic bonding, good conductivity (e.g., iron, aluminum, copper)
Ceramics	Inorganic, non-metallic solids (e.g., oxides, carbides, nitrides)
Polymers	Large molecular chains (plastics, rubbers, fibers)
Composites	Multi-phase materials combining two or more constituents
Semiconductors	Materials with intermediate electrical conductivity
Biomaterials	Materials designed for medical/biological applications
Nanomaterials	Materials with structural features at the nanometer scale

#### Crystal Structure Terms

Understanding crystal structure terminology is fundamental to materials science. Key terms include:

- Lattice:** Regular arrangement of points in space
- Unit cell:** Smallest repeating unit of a crystal structure
- Miller indices:** Notation system for crystallographic planes (e.g., (111), [100])
- Defect:** Imperfection in crystal structure (point, line, planar, volume)
- Dislocation:** Line defect in crystal lattice

- **Grain boundary:** Interface between two grains/crystals
- **Amorphous:** Non-crystalline, lacking long-range order

## Mechanical Properties

Property	Symbol	Unit	Description
Young's modulus	E	GPa	Stiffness; resistance to elastic deformation
Yield strength	$\sigma_y$	MPa	Stress at which plastic deformation begins
Ultimate tensile strength	UTS	MPa	Maximum stress before fracture
Hardness	H	HV/HB/HR	Resistance to localized plastic deformation
Ductility	—	%	Ability to deform plastically before fracture
Toughness	KIC	MPa·m <sup>1/2</sup>	Resistance to fracture under stress
Fatigue limit	—	MPa	Maximum stress for infinite cyclic loading
Creep	—	—	Time-dependent deformation under constant stress

## Thermal Properties

- **Thermal conductivity:** Ability to conduct heat (W/m·K)
- **Specific heat capacity:** Heat required to raise temperature (J/kg·K)
- **Thermal expansion coefficient:** Dimensional change with temperature ( $\alpha$ , 1/K)
- **Melting point:** Temperature of solid-liquid transition
- **Glass transition temperature (T<sub>g</sub>):** Temperature where polymer becomes rubbery

Mohamed Kheider University of Biskra

Second Year Level All Groups

Faculty of Exact Sciences

Semester 02 English Lessons

Department Sciences of Matter

Academic Year: 2025/2026

Prepared by: **Dr. OUAAR Fatima**

A Comprehensive Reference Guide

## Processing & Manufacturing

Term	Meaning
Casting	Pouring liquid metal into a mold
Forging	Shaping metal by compressive forces
Rolling	Reducing thickness by passing through rolls
Extrusion	Pushing material through a die
Sintering	Heating powder compact to bond particles
Annealing	Heat treatment to reduce hardness, increase ductility
Quenching	Rapid cooling to increase hardness
Tempering	Reheating quenched steel to reduce brittleness
CVD	Chemical Vapor Deposition
PVD	Physical Vapor Deposition
Additive manufacturing	3D printing of materials

## 2. Common Academic Phrases

### Describing Properties

- The material exhibits superior / excellent / outstanding mechanical properties
- The alloy demonstrates enhanced corrosion resistance compared to...
- The composite shows a significant improvement in tensile strength
- This ceramic possesses exceptional thermal stability
- The polymer displays remarkable flexibility at low temperatures

### Comparing Materials

- In contrast to conventional steels, this alloy...
- Unlike pure aluminum, the alloy exhibits...
- Compared to the baseline material, the modified sample shows...
- The performance is comparable to / superior to / inferior to...

### Explaining Mechanisms

- The strengthening mechanism can be attributed to...
- This phenomenon is governed by...
- The degradation process is driven by...
- The observed behavior stems from...
- These results suggest that... plays a critical role

### Presenting Data

- As shown in Figure 1, the hardness increases with...
- The data reveal a linear relationship between...
- A sharp decline in strength was observed at...
- The results indicate that...
- It is evident from the data that...

### 3. Research Paper Structure Phrases

#### Abstract

- This study investigates / examines / explores...
- The objective of this work is to...
- The results demonstrate that...
- These findings have implications for...

#### Introduction

- Despite extensive research, the mechanism remains unclear...
- There is a growing demand for materials with...
- Previous studies have focused primarily on...
- However, limited attention has been paid to...

#### Experimental Section

- The samples were prepared by...
- Characterization was performed using...
- Mechanical testing was conducted in accordance with ASTM standards...
- Microstructural analysis was carried out via SEM/TEM/XRD...

#### Results & Discussion

- The microstructure consists of...
- A typical example is shown in...
- The fracture surface exhibits...
- This is consistent with previous findings...
- The discrepancy can be explained by...

#### Conclusion

- In summary, this study has demonstrated...
- The key findings are as follows:...
- Future work will focus on...

## 4. Abbreviations & Acronyms

Abbreviation	Full Form
SEM	Scanning Electron Microscopy
TEM	Transmission Electron Microscopy
XRD	X-Ray Diffraction
XPS	X-Ray Photoelectron Spectroscopy
AFM	Atomic Force Microscopy
DSC	Differential Scanning Calorimetry
TGA	Thermogravimetric Analysis
EDS/EDX	Energy Dispersive X-ray Spectroscopy
HRTEM	High-Resolution TEM
EBSD	Electron Backscatter Diffraction
ASTM	American Society for Testing and Materials
ISO	International Organization for Standardization
HIP	Hot Isostatic Pressing
SLM	Selective Laser Melting
EBM	Electron Beam Melting
CVD	Chemical Vapor Deposition

## 5. Common Mistakes to Avoid

Incorrect	Correct
The material is very strong	The material exhibits high strength
The sample was broken	The sample fractured / failed
The test was done	The test was conducted / performed
We see from the graph	It is evident from the graph
This material is good for...	This material is suitable for...
The results are shown in Fig. 1	The results are presented in Figure 1
We did an experiment	An experiment was conducted

Mohamed Kheider University of Biskra

Faculty of Exact Sciences

Department Sciences of Matter

Prepared by: **Dr. OUAAR Fatima**

Second Year Level All Groups

Semester 02 English Lessons

Academic Year: 2025/2026

A Comprehensive Reference Guide

## 6. Useful Resources

### Recommended Journals

- Acta Materialia
- Materials Science and Engineering: A
- Journal of Materials Science
- Scripta Materialia
- Advanced Materials
- Nature Materials
- Materials Today

### Reference Books

- Materials Science and Engineering: An Introduction - Callister & Rethwisch
- The Science and Engineering of Materials - Askeland & Phulé
- Structure and Properties of Engineering Alloys - Smith
- Introduction to Physical Metallurgy - Avner

### Online Resources

- MatWeb - Material properties database ([www.matweb.com](http://www.matweb.com))
- ASM International Handbooks
- NIST Materials Data Repository
- MatNavi - NIMS Materials Database