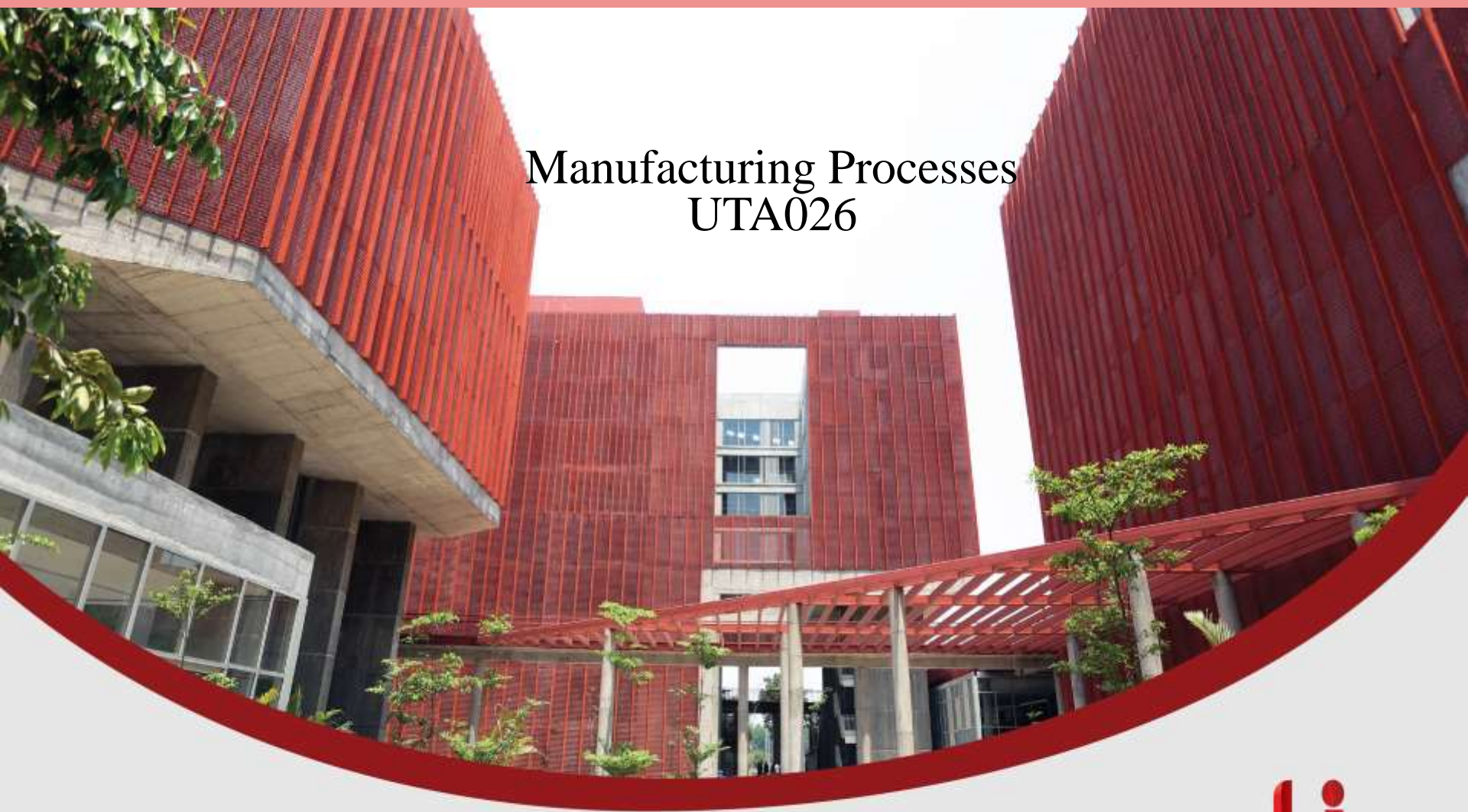


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Manufacturing Processes UTA026



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CUTTING TOOL MATERIAL

- Success in metal cutting depends on the selection of the proper cutting tool (material and geometry) for a given work material.
- A cutting tool must have the *following characteristics* in order to produce good quality and economical parts:

TOUGHNESS

HOT
HARDNESS

WEAR
RESISTANCE

TOUGHNESS

- *To avoid fracture failure*, the tool material must possess high toughness.
- Toughness is the capacity of a material to *absorb energy without failing*.
- It is usually characterized by a *combination* of *strength and ductility* in the material.

HOT HARDNESS

- Hot hardness is the ability of a material to *retain its hardness at high temperatures*.
- This is required because of the high-temperature environment in which the tool operates.

WEAR RESISTANCE

- Wear is the erosion of material from a solid surface by the action of another surface.
- The *ability* of a metal *to resist* the gradual *wearing* away caused by abrasion and friction is called wear resistance.
- All cutting-tool materials must be hard.

Desirable characteristics of a cutting tool material

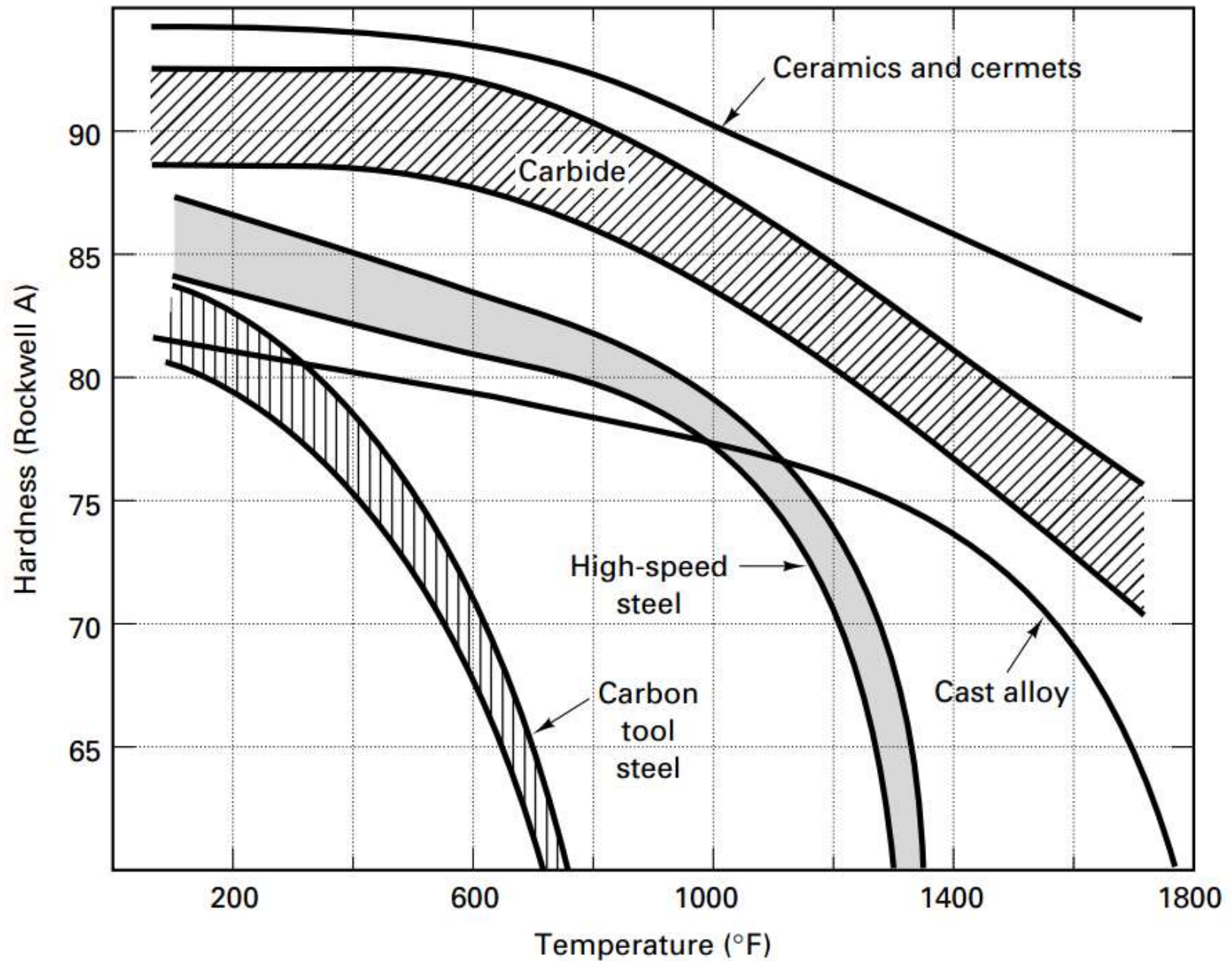
1. High *hardness*
2. High hardness temperature, *hot hardness*
3. *Resistance to abrasion*, wear due to severe sliding friction
4. *Resistance to Chipping of the cutting edges*
5. *High toughness* (impact strength)

Desirable characteristics of a cutting tool material

6. *Strength* to resist bulk deformation
7. *Good chemical stability*
8. *Adequate thermal properties*
9. *High elastic modulus (stiffness)*
10. *Correct geometry* and *surface finish*

TOOL MATERIALS CATEGORIES

- 1. High carbon tool steel*
- 2. High-speed Steels*
- 3. Cast Cobalt Alloys (Stellite)*
- 4. Carbides*
- 5. Ceramics*
- 6. Synthetic Diamond & CBN*



Source: Kalpakjian

1. HIGH-SPEED STEEL(HSS)

- *High-speed steel(HSS)* is a highly alloyed tool steel capable of maintaining *hardness at elevated temperatures* better than high carbon and low alloy tool steels.
- Its good hot hardness permits tools made of HSS to be used at *higher cutting speeds*.
- HSS is especially suited to applications involving complicated tool geometries, *such as drills, taps, milling cutters, and broaches*.

1. HIGH-SPEED STEEL(HSS)

- A wide variety of high-speed steels are available, but they can be divided into two basic types:

*Tungsten
Type*

*Molybdenum
Type*

1. HIGH-SPEED STEEL(HSS)

(a) TUNGSTEN-TYPE

- Tungsten-type HSS contains tungsten (W) as its principal alloying ingredient.
- Additional alloying elements are chromium (Cr), and vanadium (V).
- One of the original and best known HSS grades is T1, or **18-4-1** high-speed steel, containing 18% W, 4% Cr, and 1% V.

Grade	<u>C</u>	<u>Cr</u>	<u>Mo</u>	<u>W</u>	<u>V</u>
T1	0.7	4.0	-	18.0	1.0

1. HIGH-SPEED STEEL(HSS)

(b) MOLYBDENUM - TYPE

- Molybdenum HSS grades contain combinations of tungsten and molybdenum (Mo), plus the same additional alloying elements as in the T-grades.
- Cobalt (Co) is sometimes added to HSS to enhance hot hardness.
- Of course, high-speed steel contains carbon, the element common to all steels.

Grade	<u>C</u>	<u>Cr</u>	<u>Mo</u>	<u>W</u>	<u>V</u>
M2	0.8	4.0	5.0	6.0	2.0

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