

Advanced Manufacturing
Technology & Prototyping
MDP494_UG:2018



Lecture 4_Part 1

Introduction to Non traditional Machining Processes

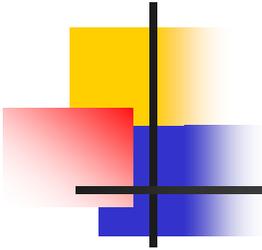
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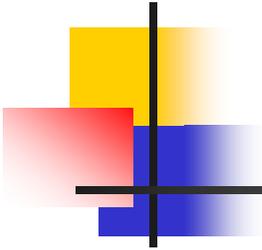
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Introduction

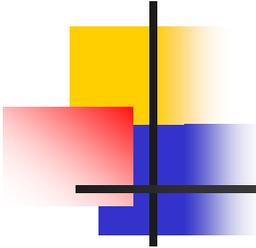
Why non traditional machining processes are needed?

- There are limitations for the traditional machining processes.
- There are continuous improving for materials' properties to be cut.
- There are continuous updating for workpiece shapes to be cut.
- There are continuous updating for requirements of machining outputs.



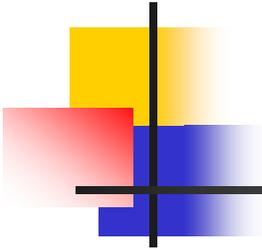
Limitations of trad. M/C processes

- The hardness and strength of the workpiece material are very high (Ex :Tungsten Carbide, Stainless Steel, Titanium and its alloysetc) or the material is too brittle.
 - *Increased workpiece hardness : decreased economic cutting speed. Hence, lower productivity.*
 - *Rapid improvements in the properties of materials (hardness, strength, etc).*
 - *Tool material hardness should be greater than workpiece hardness.*



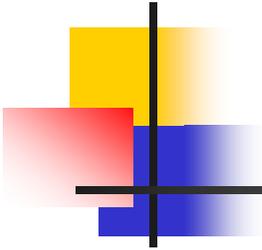
Limitations of trad. M/C processes, cont.

- The workpiece is too flexible to withstand the cutting or grinding forces.
- The shape of the part is complex.
- Surface finish and tolerances better than those obtained by other processes are required.
- Temperature rise in the work piece are undesirable.



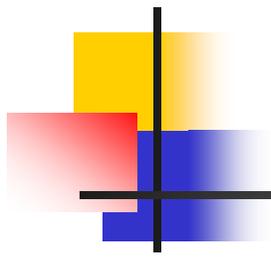
Recently Product Requirements

- Complex shapes
- Machining in inaccessible areas
- Low tolerances (say, 0.01 mm)
- Better surface integrity (no surface defects, etc.)
- High surface Finish (Nano-level Ra value)
- Miniaturization of products (examples: landline phone & mobile, old computers & laptop, etc.)



Recently Product Requirements, cont.

- High MRR
- High production rate while processing difficult to machine.
- Low cost of production .
- Precision and ultra precision machining
- Requires material removal in the form of atoms and / or molecules

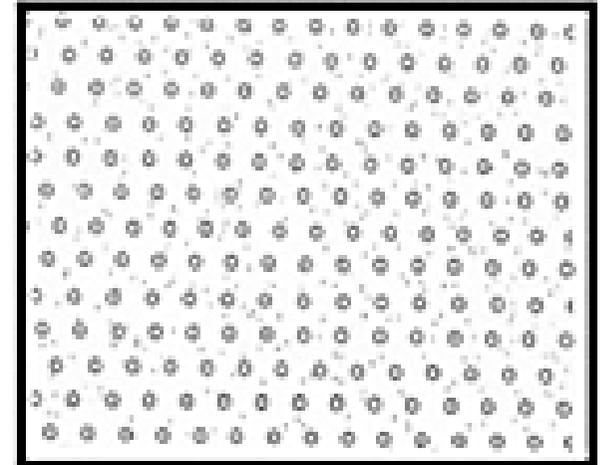
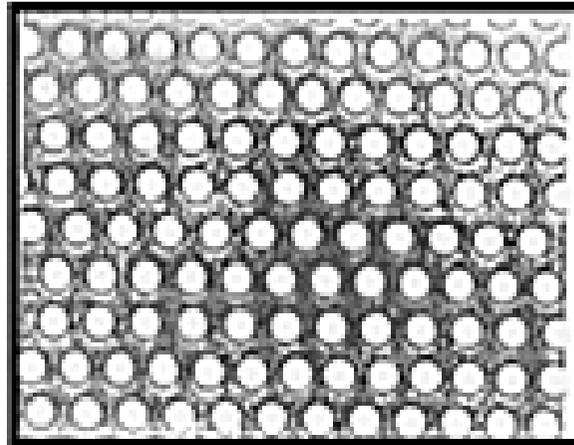
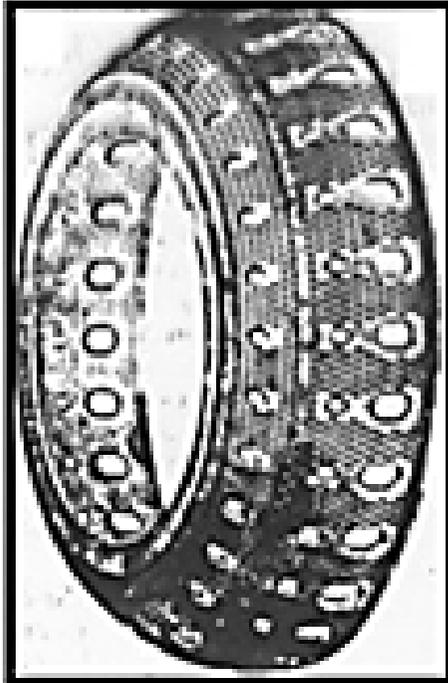


EXAMPLES FOR MACHINING OF COMPLEX SHAPED WORKPIECES

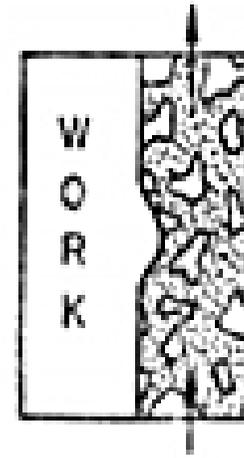
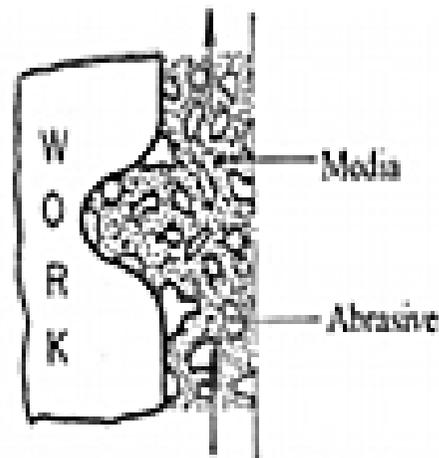
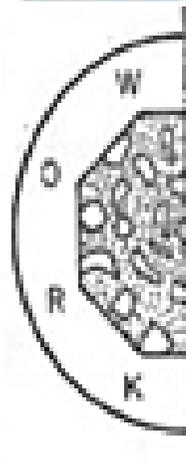
**PART OF A HELICOPTER
TURBINE - HOLES DRILLED
BY EDM**

HOLE=0.09 mm ϕ HOLES DENSITY = 4000/cm²
WORKPIECE- S.S.;
THICK = 0.2 MM; TIME = 10 μ S/HOLE

HOLE ϕ = 0.006 mm (6 μ m);
HOLES DENSITY = 200,000 / cm² ;
THICKNESS = 0.12 mm; TIME = 2 μ s / HOLE

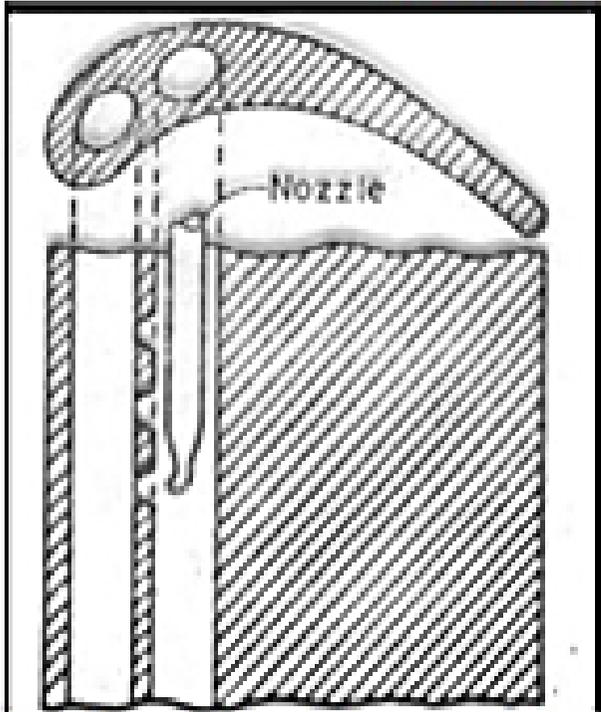


AFF MEDIM ACTS AS A SELF-DEFORMABLE STONE

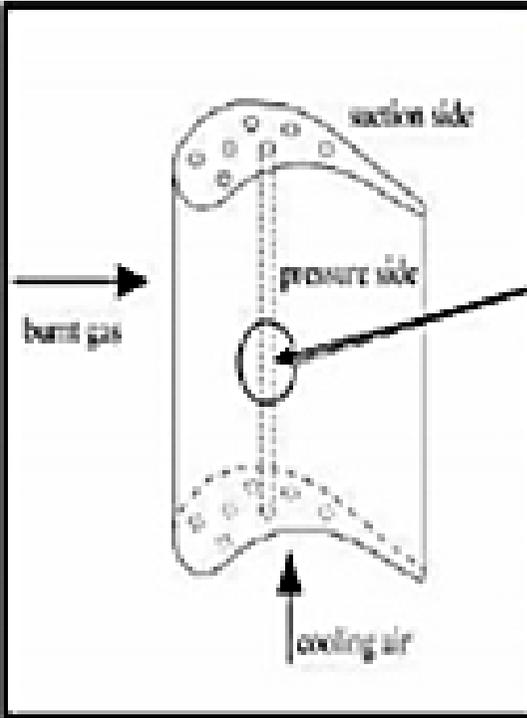


ELECTROCHEMICAL MACHINING

Contoured Hole and Finished by AFF Drilled in Inconel Using ECM

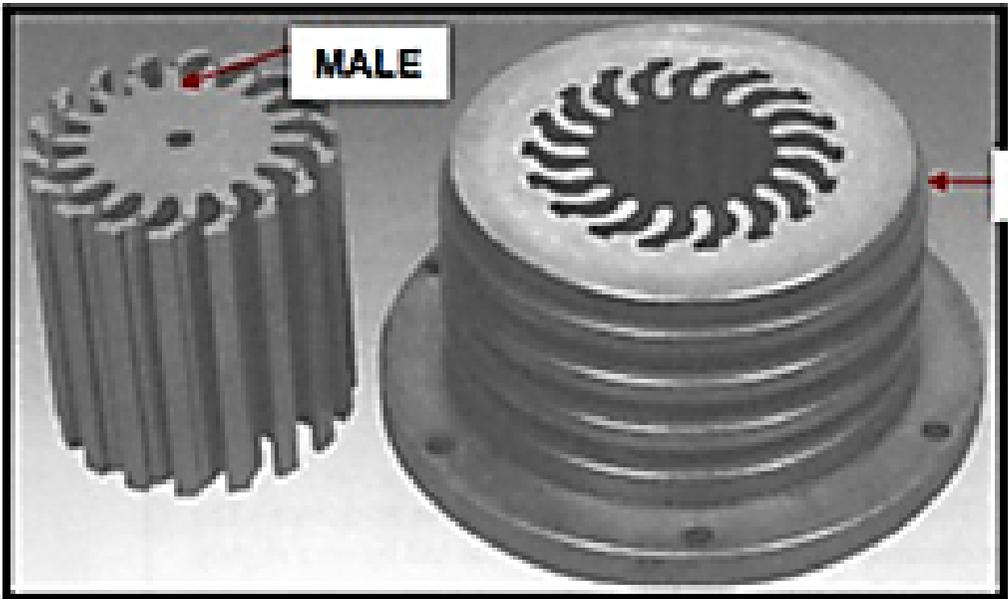


HOLE NORMAL TO THE WALL

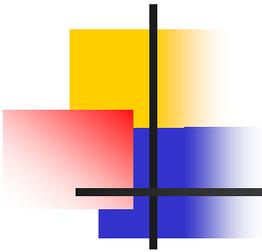


Turbine Blade with cooling Holes

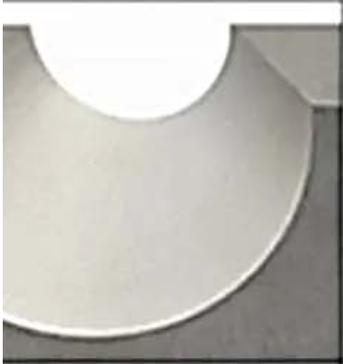
EXPERIMENTAL PARAMETERS	EXPERIMENTAL PROFILE	COMPARISON WITH THEORETICAL PROFILE	PHOTOGRAPH OF MACHINED PROFILE/HOLE
Experiment No.3 Voltage: 10.5V Feed rate: (0.7 mm/min) Feed rate: (0.6 mm/min)			



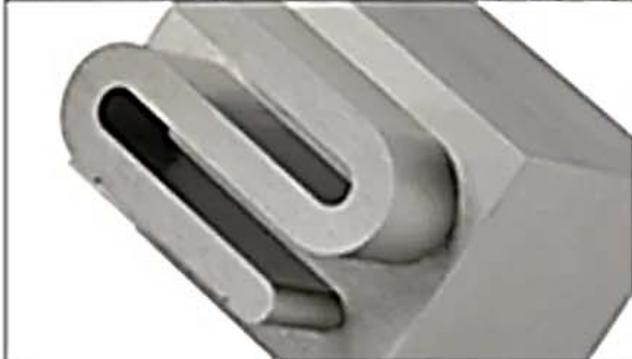




Taper Cutting



High Tolerance fitting

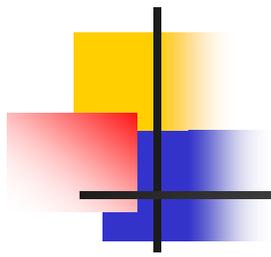


Ultra Thin Wire

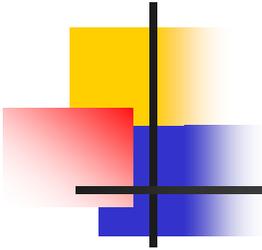


Special Material



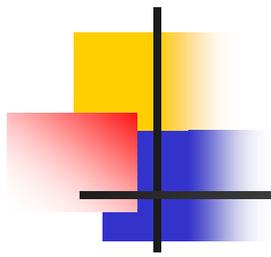


Important characteristics of Non Traditional Machining Processes (NTMPs)



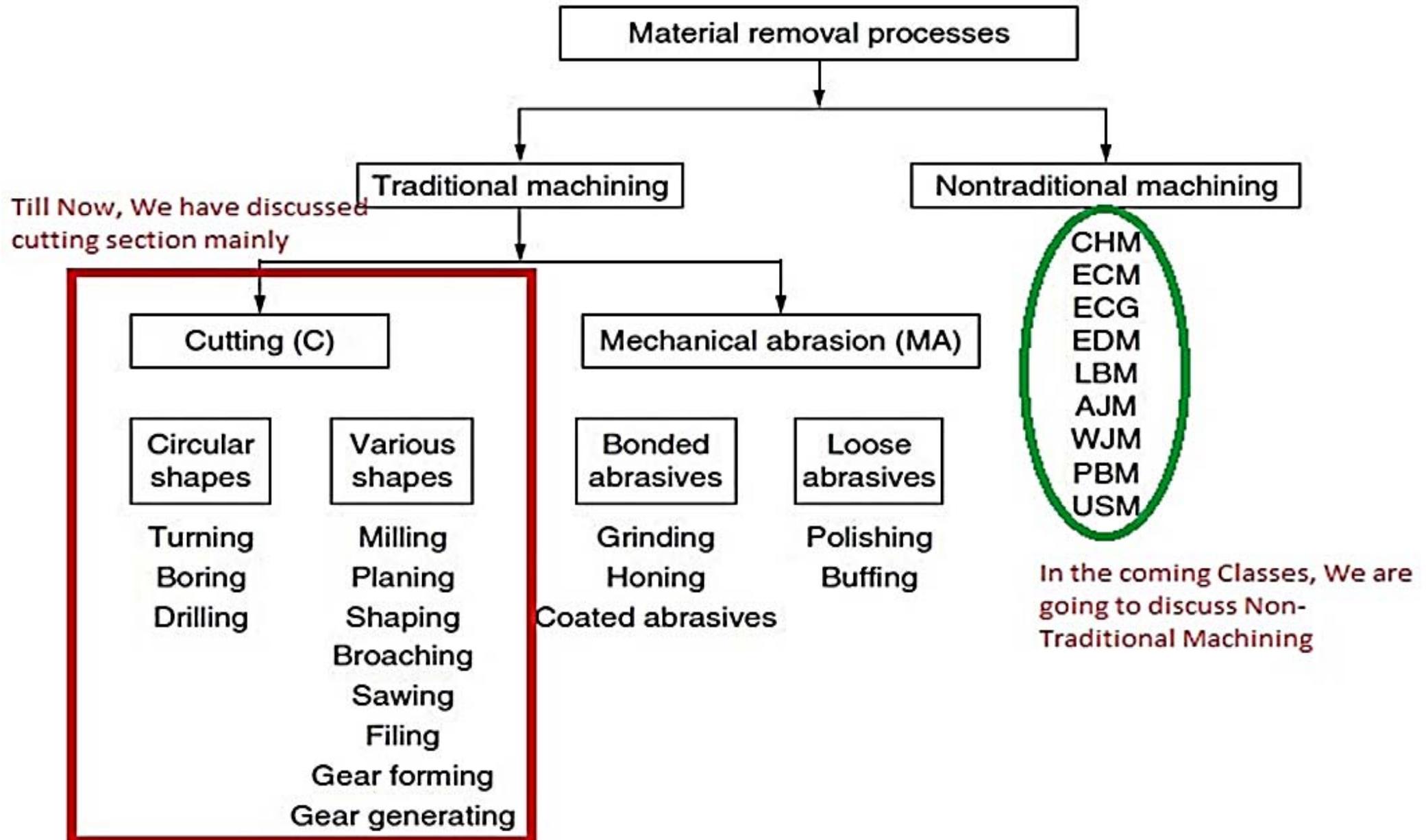
Characteristics of NTMPs:

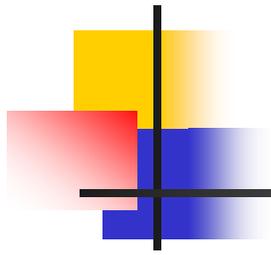
- Process performance is independent of workpiece properties: *Strength & Hardness are not barriers.*
- Performance depends on thermal, electrical and chemical properties of workpiece materials.
- Uses different kinds of energy in direct form to remove the material.
- In general, low MRR but better quality products.
- Comparatively high initial investment cost of machine tools and high operating cost.



CLASSIFICATION OF MATERIAL REMOVAL PROCESSES (MRPS)

Classification of MRPs:





CLASSIFICATION OF NTMPS /ADVANCED MACHINING PROCESSES (AMP)

CLASSIFICATION OF ADVANCED MACHINING PROCESSES

MECHANICAL

MACHINING

ABRASIVE JET MACHINING (AJM)

ULTRASONIC MACHINING (USM)

WATER JET MACHINING (WJM)

ABRASIVE WATER JET MACHINING (AWJM)

FINISHING

ABRASIVE FLOW FINISHING (AFM)

MAGNETIC ABRASIVE FINISHING (MAF)

MAGNETORHEOLOGICAL FINISHING (MRF)

THERMOELECTRIC

PLASMA ARC MACHINING (PAM)

LASER BEAM MACHINING (LBM)

ELECTRON BEAM MACHINING (EBM)

ELECTRIC DISCHARGE MACHINING (EDM)

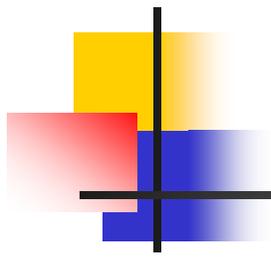
ION BEAM MACHINING (IBM)

ELECTROCHEMICAL & CHEMICAL

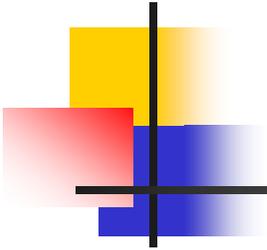
ELECTROCHEMICAL MACHINING (ECM)

CHEMICAL MACHINING (CHM)

BIOCHEMICAL MACHINING (BM)



Classification of NTMPs/AMPs according to cut material properties

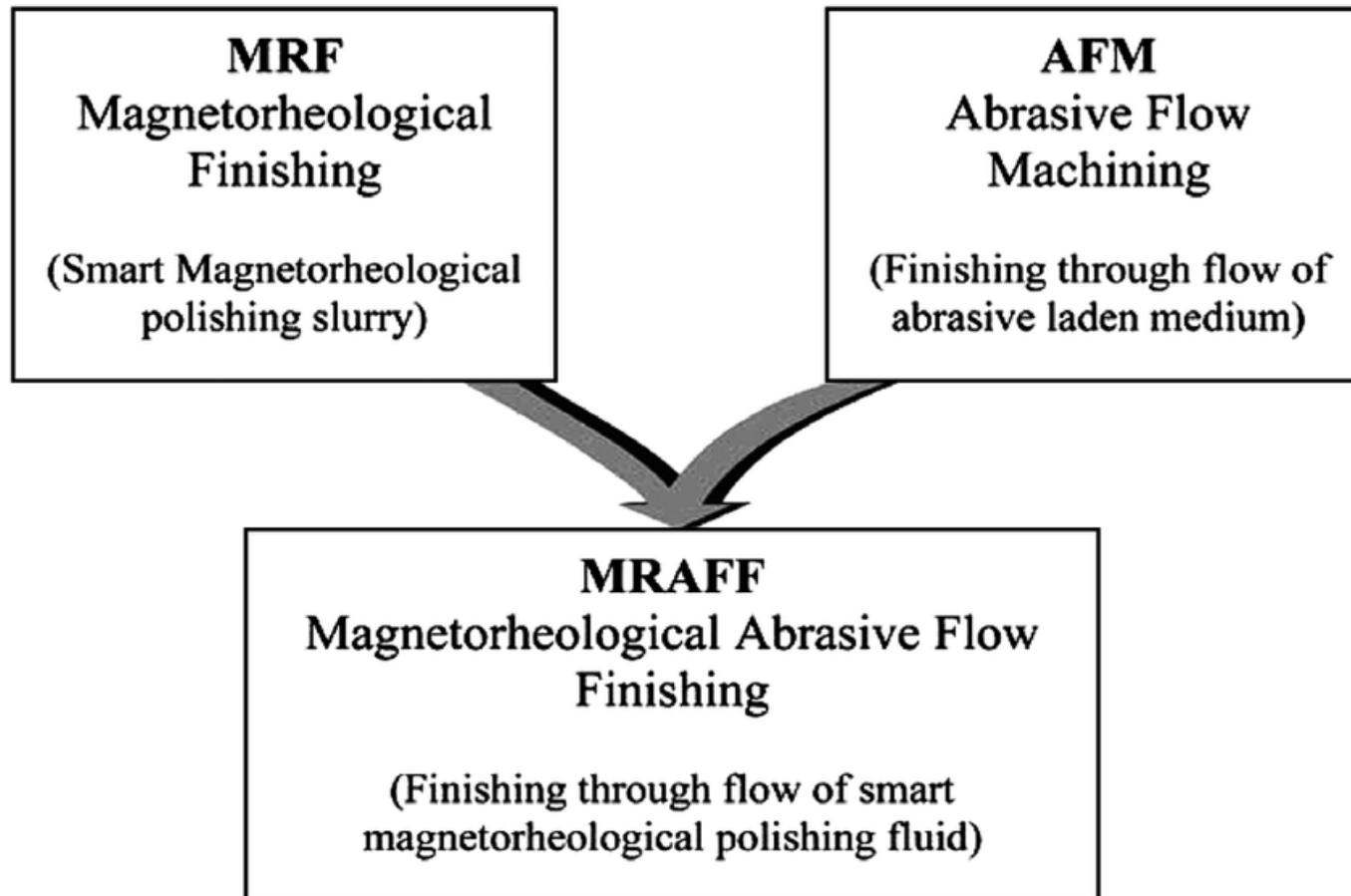


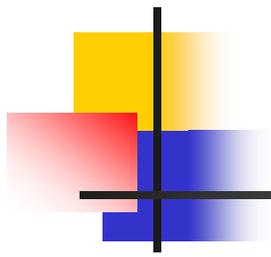
Classification:

- Applicable only for Electrically Conducting Materials : ECM, EDM, EBM.
- Applicable for both electrically conducting & non – conducting materials: USM , AJM, LBM, etc.
- Thermal conductivity, Reflectivity, etc. also play an important role in some processes: LBM, Plasma

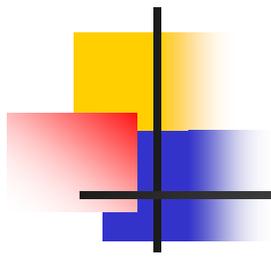
Classification, cont.:

- Applicable for Non Magnetic materials : MAF, MRF, etc.





QUESTIONS?



END