VEMU INSTITUTE OF TECHNOLOGY

DEPARTMENT OF MECHANICAL ENGINEERING

MATERIAL SCIENCE LABORATORY

(20A03201P)

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LIST OF EXPERIMENTS

List of Experiments:

1. Metallography sample preparation
2. Microstructure of pure metals – Iron, copper and aluminum as per ASTM standards
3. Microstructure of low carbon steel, mild steel and high carbon microstructure of cast irons.
4. Microstructure of non-ferrous alloys – aluminum, copper, titanium, nickel and their alloys.
5. Hardenability of steels by Jominy End Quench Test.
6. Microstructure of heat treated steels.
7. Hardness of various untreated and treated steels.
8. Microstructure of ceramics, polymeric materials.
9. Microstructure of super alloy and nano-materials.
10. Hardness of ceramics, super alloys, nano-materials and polymeric materials (one sample on each)

COURSE OBJECTIVES

- To understand the microstructure and hardness of engineering materials.
- To explain grain boundaries and grain sizes of different engineering materials.

COURSE OUTCOMES

The student is able to

- Differentiate various microstructures of ferrous and non-ferrous metals and alloys. (l4)
- Visualize grains and grain boundaries. (l3)
- Importance of hardening of steels. (l2)
- Evaluate hardness of treated and untreated steels. (l4)
- Differentiate hardness of super alloys, ceramics and polymeric materials

INTRODUCTION

Materials science teaches us what things are made of and why they behave as they do. Materials engineering shows us how to apply knowledge to make better things and to make things better. Materials science and engineering drives innovation in both research and industry in everything from aerospace to medicine

MACHINERY USED IN THE LAB

Fig: 1 Cut-Off Machine

Fig :2 Belt Grinding

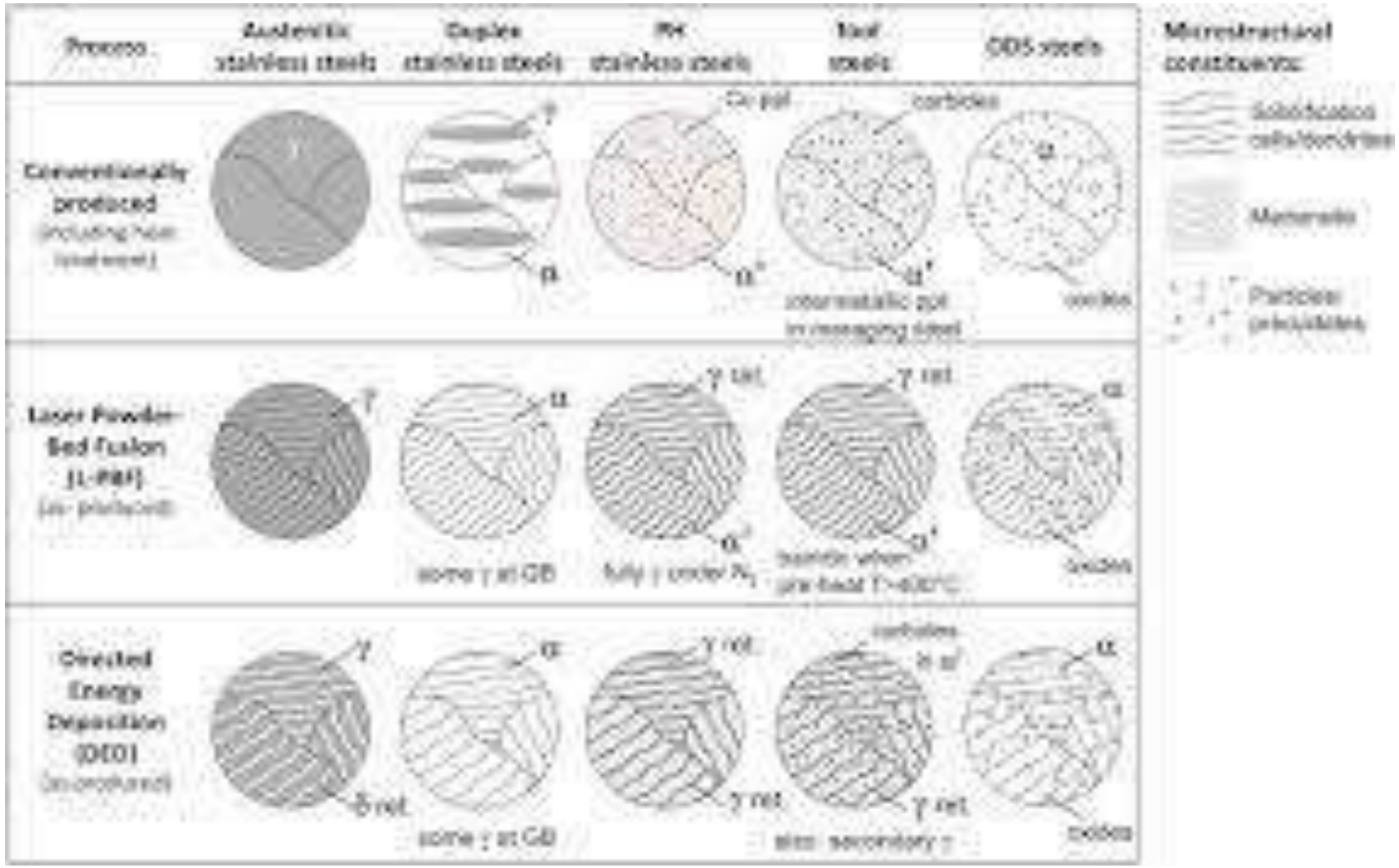
Fig (3) **Disc Polishing**

Fig (4) Etching

Fig (5) Microscope

Etchant	Composition	Materials Etched
Nital	4% HNO_3 + 96% C_2H_5OH	All steels (except stainlesssteels)
$FeCl_3$	$FeCl_3$ + HCl + Water	Brass
Aqua Regia	60% HCl + 20% HNO_3 +20% H_2O	Stainless steel
HF	% HF + 98% H_2O	AL & its alloys
Kellars	1% HF + 1.5% HCl + 2.5%	Duralumin
Reagent	HNO_3+95% H_2O	
H_2O_2	5% H_2O_2+5% NH_3OH+90% H_2O	Cu, Brass, Bronze


1 CUTTING
2 MOUNTING
GRINDING 3
4 POLISHING
5 METALLOSCOPY


Process
Austenitic stainless steels
Duplex stainless steels
PH stainless steels
Tool steels
ODS steels
Microstructural constituents:
Substructures
cells/dendrites
Memoranda
Particles/precipitates
Conventionally produced
Laser Powder-Bed Fusion (L-PBF)
Directed Energy Deposition (DED)
γ
α
α'
carbides
oxides
γ ret.
δ ret.
some γ at GB
fully γ under N2
some γ at GB
some secondary γ


Eyepieces
(Ocular Lens)
Head
Arm
(Frame)
Diopter Adjustment
Nose Piece
Objective Lenses
Aperture
Stage
Controls
Stage Clip
Mechanical
Stage
Coarse
Adjustment
Condenser
Fine
Adjustment
Illumination
Light Switch
Brightness
Adjustment
Base