



Topics for Metalloscope

Emerging Trends and Innovations

1. **High-Entropy Alloys (HEAs):** Properties, processing, and applications in extreme environments.
2. **Atom Probe Microscopy:** Atomic-scale 3D compositional mapping of advanced materials.
3. **Additive Manufacturing:** Applications in space industry (example: rocket parts etc)
4. **Shape Memory Alloys:** Applications in biomedical, aerospace, and robotics/ Underlying metallurgy for the specific properties of these alloys.
5. **Nanostructured Materials/ Nanomaterials:** Synthesis and applications in coatings and catalysts/ Morphology & correlation of properties with grain boundary in these materials
6. **Smart Materials:** Adaptive materials for sensors and actuators.

Sustainability and Green Technologies

1. **Aluminium v/s Steel:** Total energy consumption v/s energy consumption on road
2. **Recycling of Rare Earth Metals:** Challenges and opportunities.
3. **Energy Materials:** Batteries, supercapacitors, and fuel cells.
4. **Green Steel Production:** Low-carbon pathways for steelmaking using hydrogen and renewable energy.

Specialized Topics

1. **Magnetic Materials:** Soft and hard magnets for electronic applications.
2. **Aerospace-Grade Materials:** Design and performance of materials for extreme aerospace environments (Superalloys).
3. **Ceramic Matrix Composites (CMCs):** High-temperature applications.
4. **Corrosion Science:** Advances in understanding and prevention/ naval catastrophes due to corrosion
5. **Materials for Space Exploration:** Challenges in vacuum and radiation environments.
6. **Manufacturing of single crystals**

Computational Metallurgy and Materials Science

1. **Machine Learning in Materials Design:** Applications in alloy development.

2. **Phase Field Modelling:** Simulating microstructure evolution.
3. **Crystal Plasticity:** Modelling of plastic deformation
4. **Software:** Requirement and applications of Abaqus-CAE/ NEPER/ FEPX/COMSOL