Nickel Based Alloy Intergranular Attack (IGA)

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Nickel Based Alloy IGA

- Pre-penetrant etch is a routine operation in the manufacturing of many components
- The operation consists in chemically removing a few microns from the surface of a component
- This is performed using an acid or an alkali solution

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- A successful pre-penetrant etch will remove the specified amount of material without causing surface damage to the part which maybe detrimental to its intended use

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- Critical process parameters are required to be monitored for pre-penetrant etch:
  - Solution composition
  - Temperature
  - Immersion time

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- Other factors and variables to control are:
  - Specimen preparation
  - Surface finish
  - Dissolved metal in solution(s)

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- Testing to insure conformity of the process include:
  - Stock loss
  - Titration
  - Total dissolved metal in solution
- Testing intervals are controlled

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- Stock loss is a know reference that can be used to replace some testing
- Stock loss cannot replace all testing

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- Supplemental or product testing
  - Dimensional
  - End grain pitting
  - Hydrogen embrittlement
  - Intergranular Attack (IGA)

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- Different categories of hardware can be etched prior to penetrant inspection
- When components go through a semi finish state the process can be different
- Can be performed locally with some etchant and on some alloys

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- Product testing intervals are controlled
- Variations in process should be validated with product testing
- Process parameters once fixed must be respected

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- Controls are in place to avoid preferential attack on metallurgical features
- IGA is a form of corrosion occurring preferentially at grain boundaries usually with slight or negligible attack on the adjacent grains

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- IGA will not be detected by the subsequent penetrant inspection
- Progression from IGA to cracks may occur
- Penetrant sensitivity is critical once indications are detected

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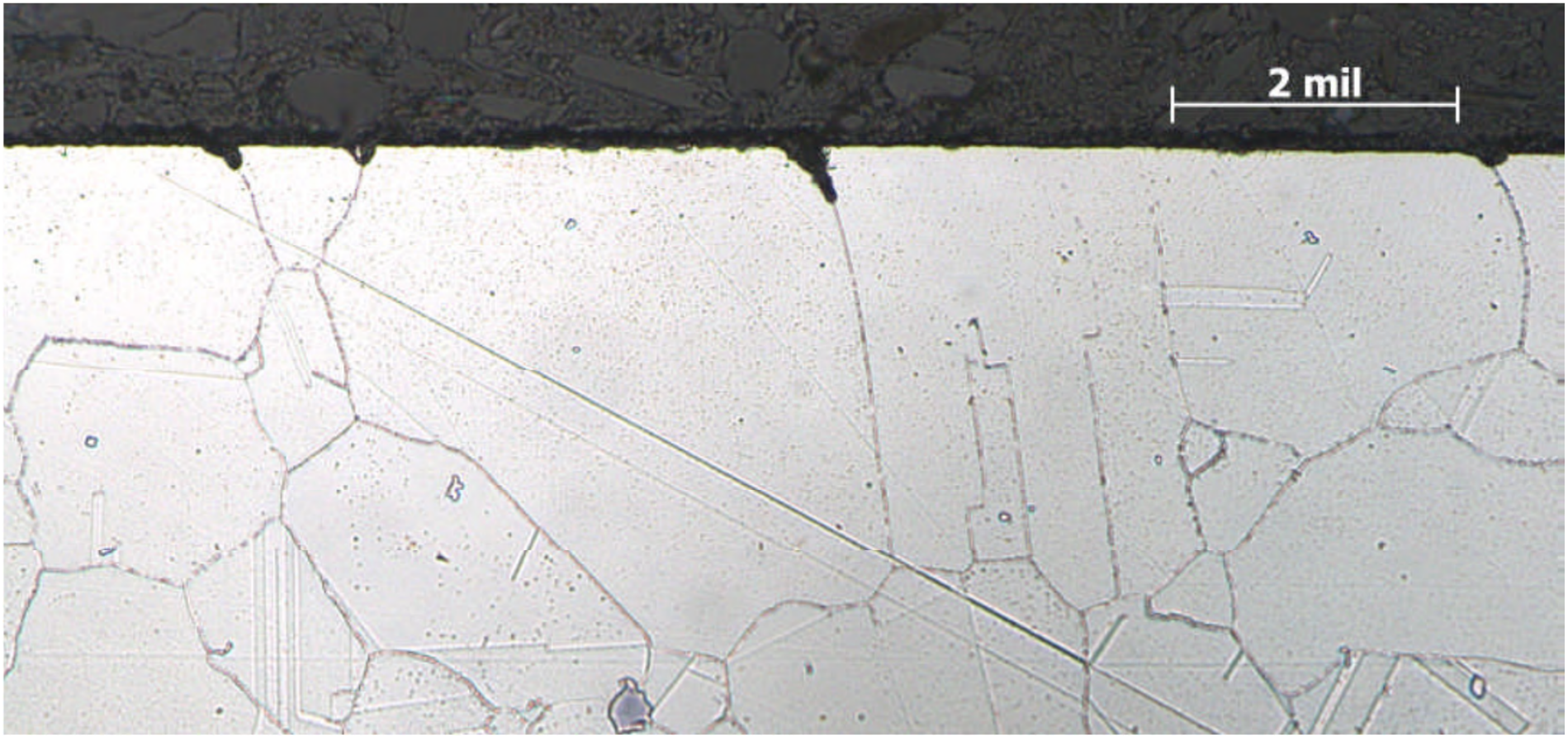

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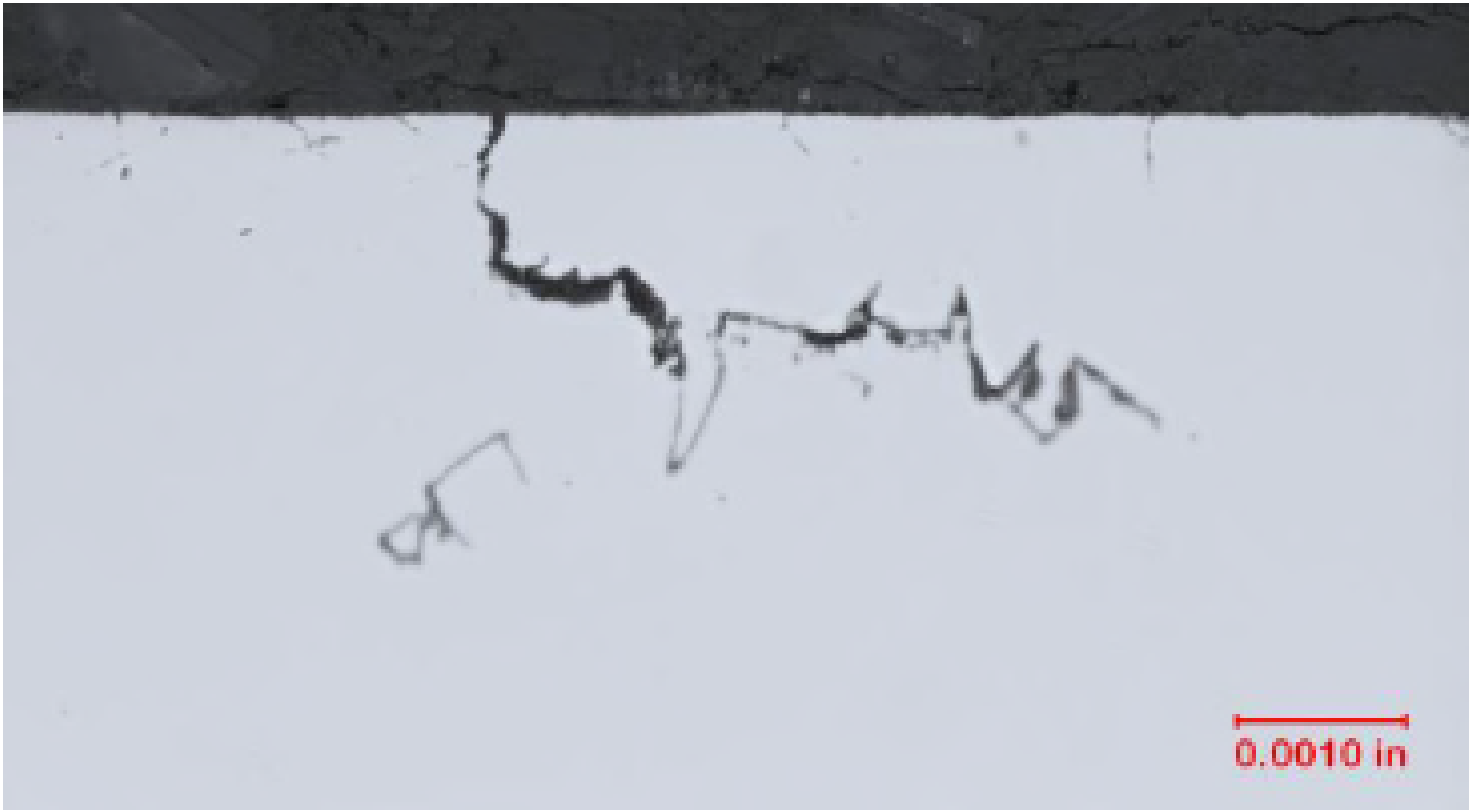

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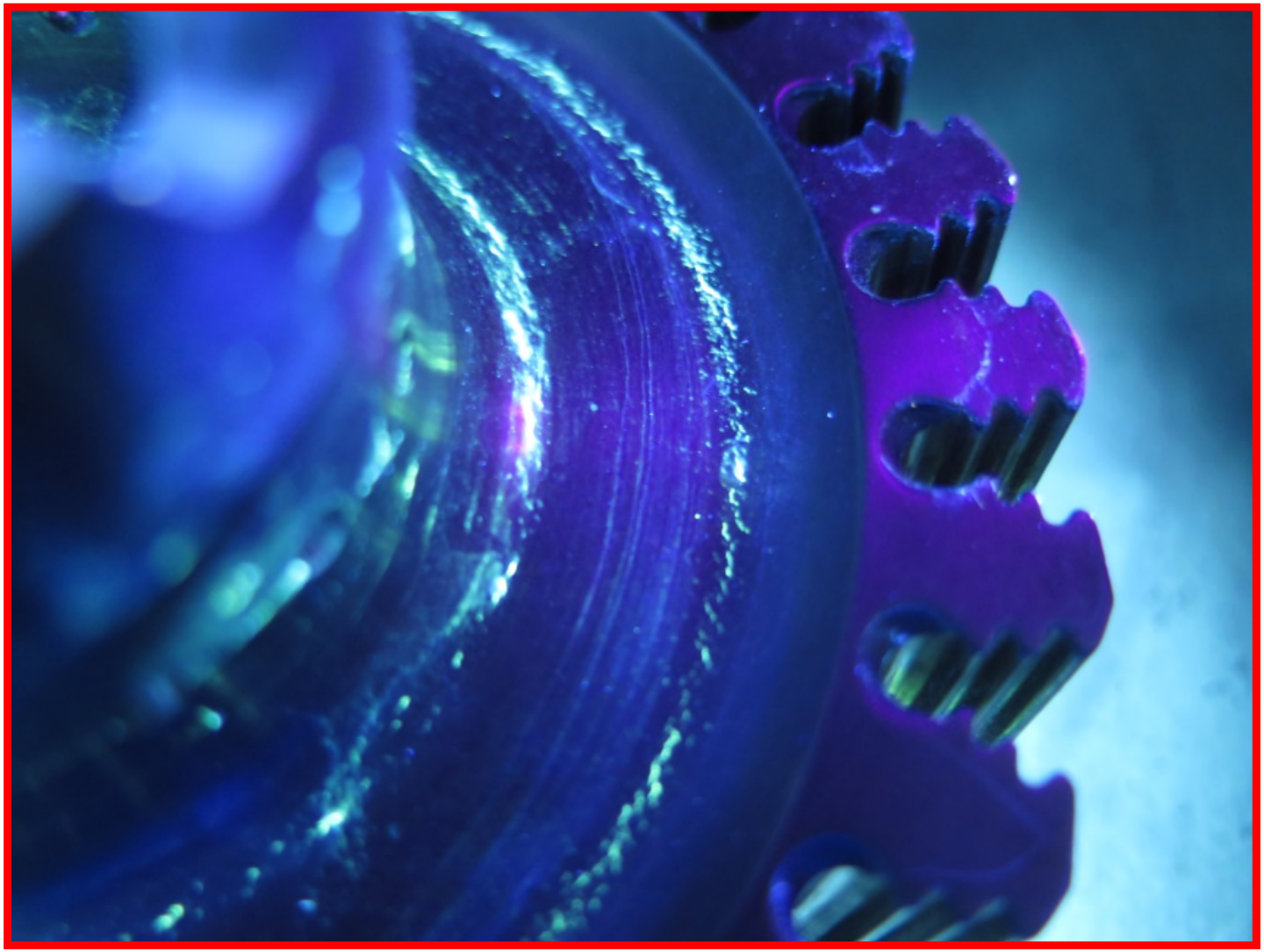

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- A uncontrolled pre-penetrant etch can result in component failure

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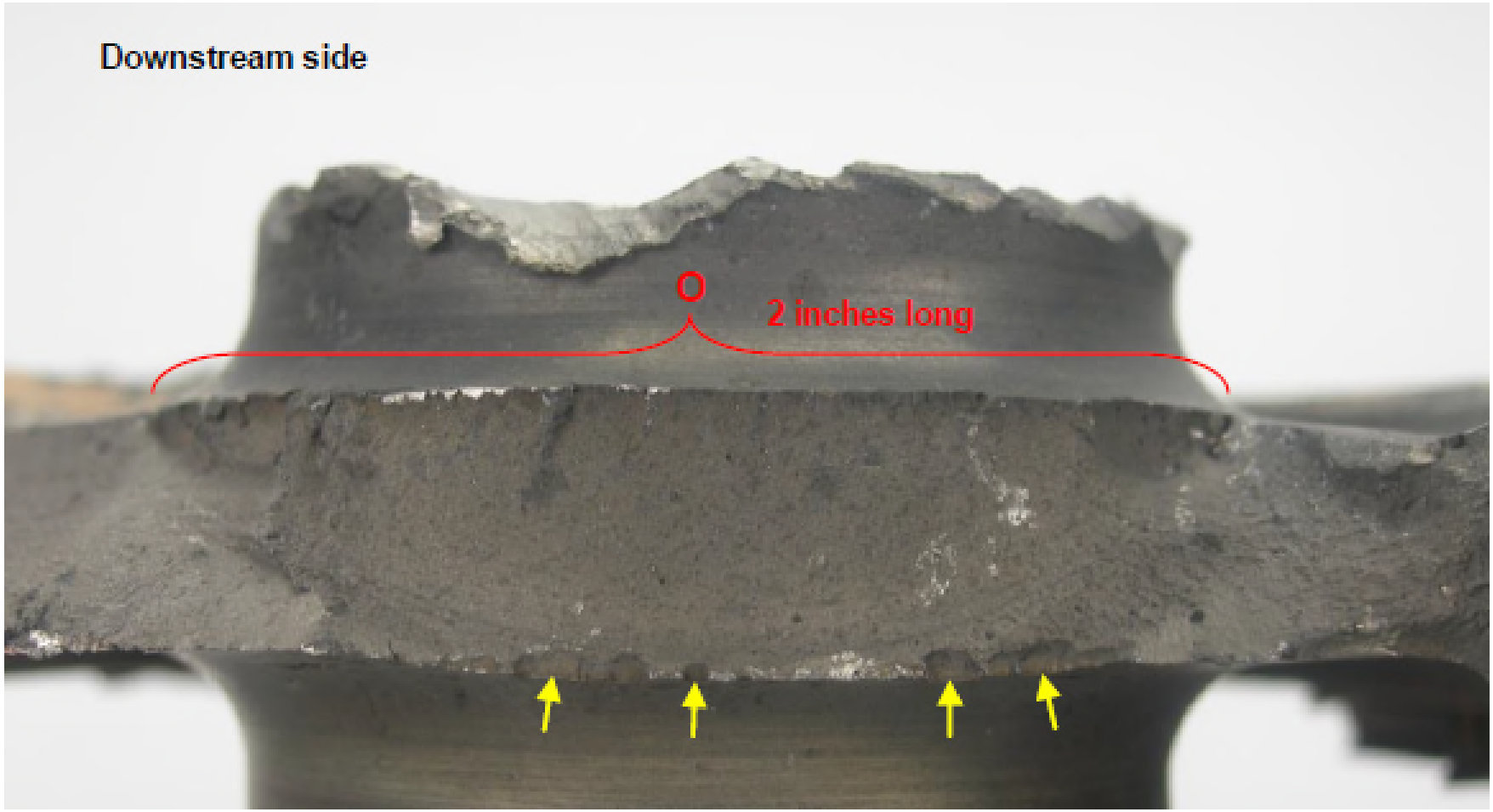

Nickel Based Alloy (IGA) Summary

- The pre-penetrant etch process criticality must not be underestimated
- The process must be monitored:
  - Controls
  - Verifications
  - Operating parameters
- Consequences in lack of process control can be catastrophic