



Additive Manufacturing Technology Transition

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Outline

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- **Additive Manufacturing (AM) Technology Background**
 - **Thermally Mediated**
 - **Strain Mediated**
- **AM Technology Transitions**
 - **Current State of the Art**
 - **Future Vision & Challenges**



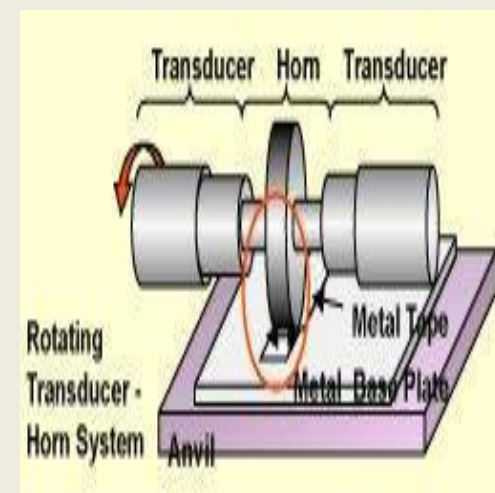
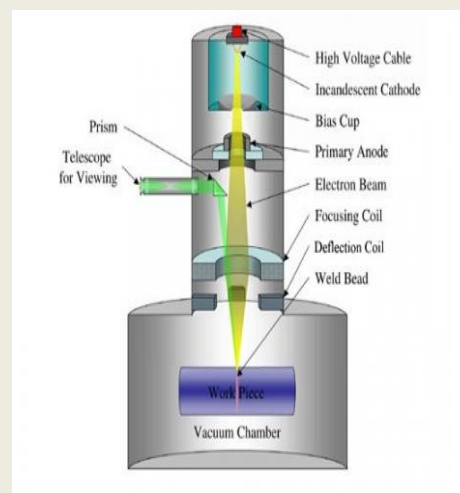
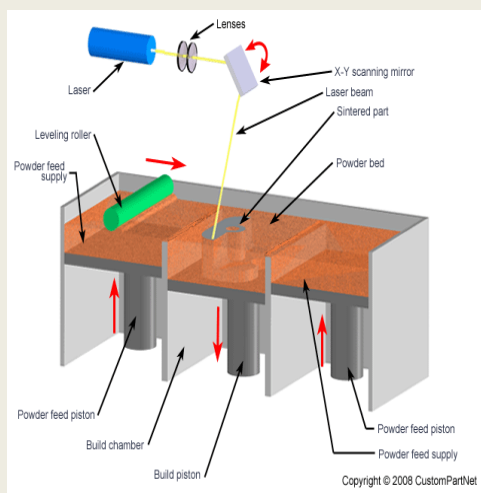
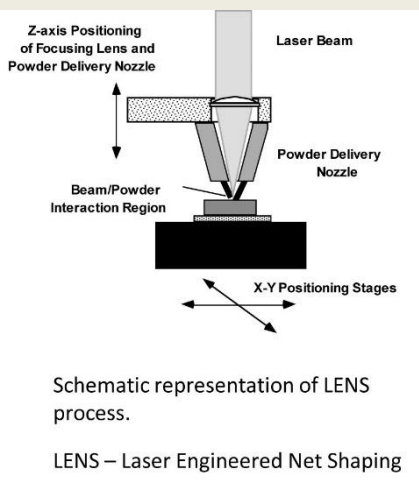
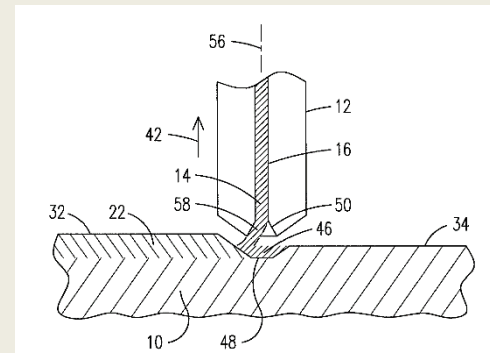
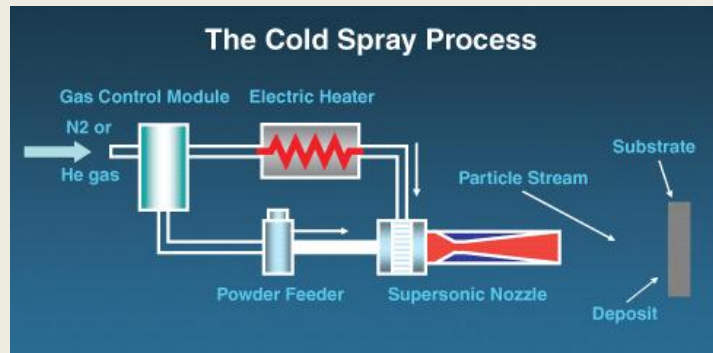
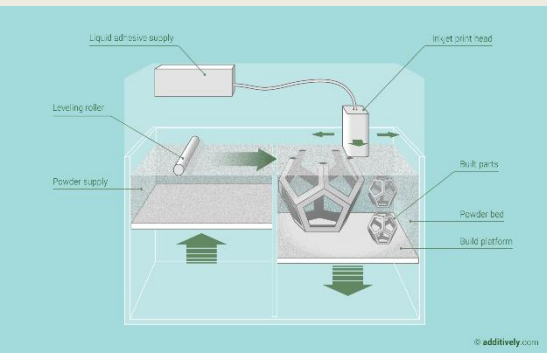
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Additive Manufacturing Overview

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Net or Near-Net shaping of added material as part or whole of a component or structure



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AM Capability Variables

Material

- Feedstock Chemistry
- Material Mixing
- Final Microstructure

Component

- Part Size & Geometry
- Dimensional Tolerance
- Surface Finish

Technology
Transfer

Process

- Build Environment
- Process Efficiency
- Build Rate
- Post-Build Processing

Production

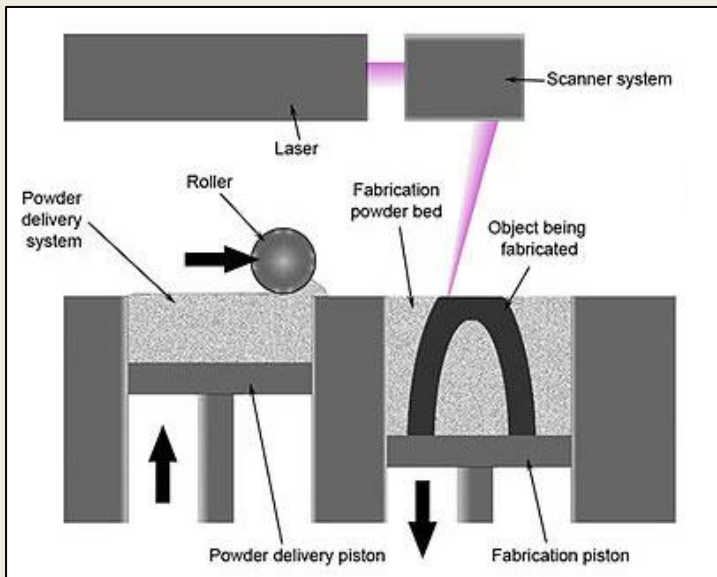
- Scalability
- Reproducibility
- Qualification



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Thermal AM

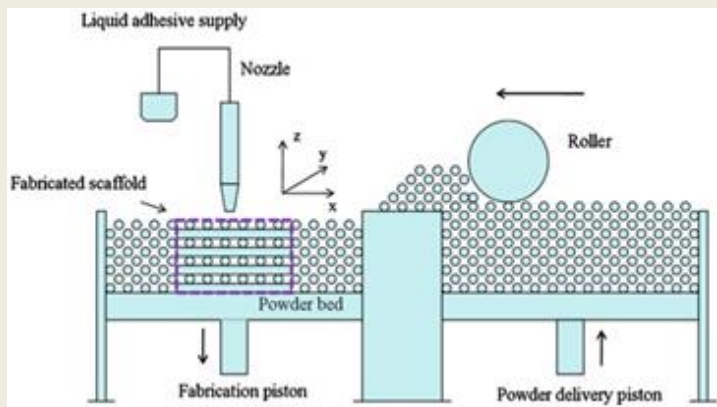
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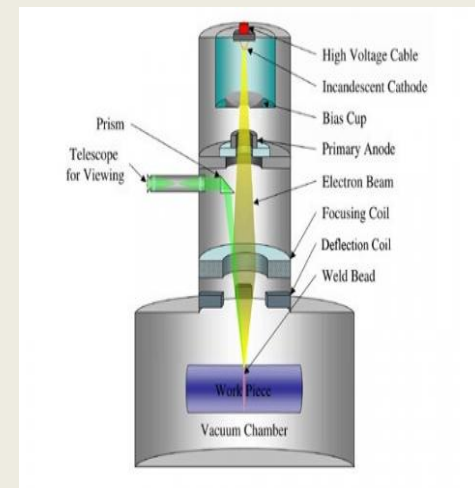
http://en.wikipedia.org/wiki/Selective_laser_sintering



Klecka_AM_Methods_CSAT_June_2014_Final



<http://fuzehub.com/fuzehub-blog/additive-manufacturing-a-new-tool-in-the-manufacturing-toolbox-4/>



<http://www.whiteclouds.com>

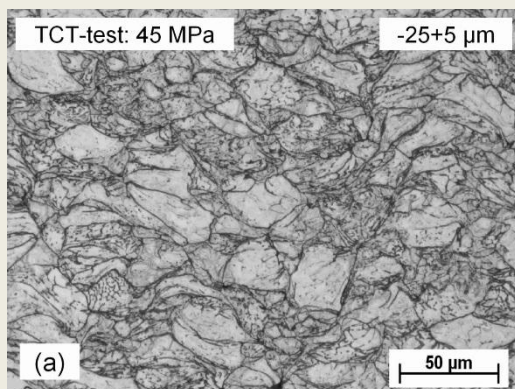
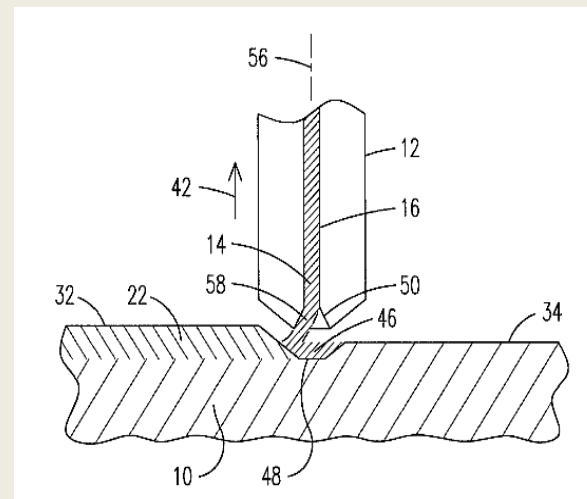
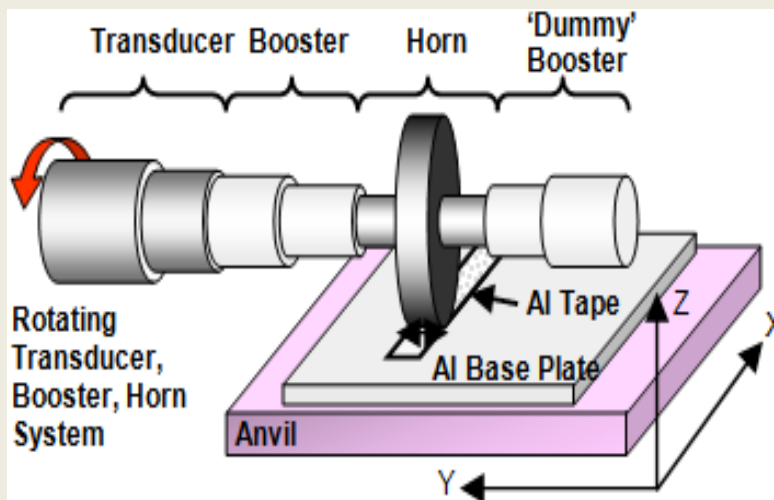
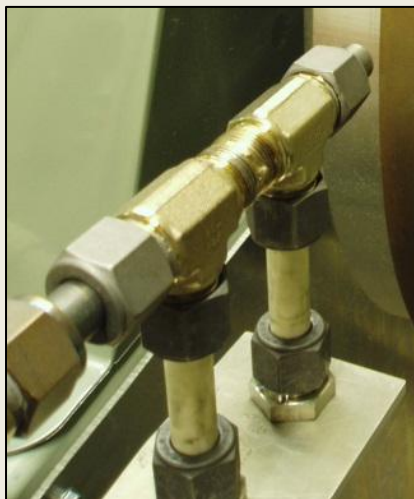


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Strain AM

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http://www.hsu-hh.de/werkstoffkunde/index.php?brick_id=PJXfoRt0286oh4lC&action=setlanguage&language=en

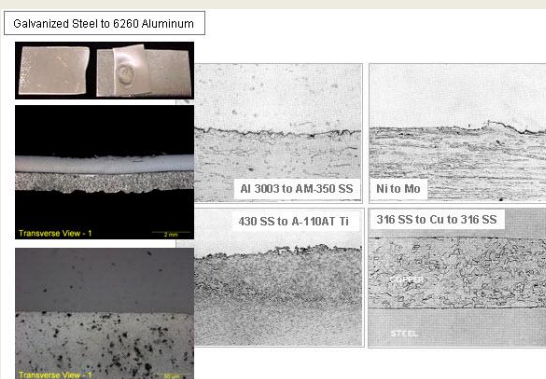
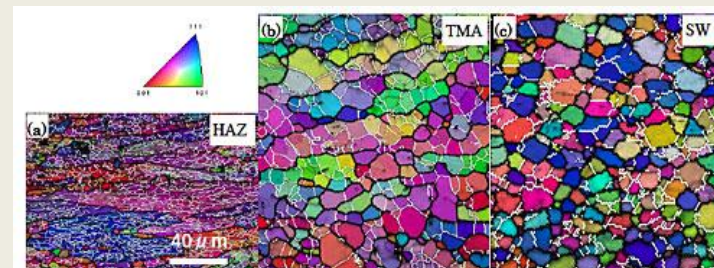


Figure 2. Examples of dissimilar metals welds prepared by ultrasonic solid-state welding.

<http://www.ewi.org>



<http://www.lm-foundation.or.jp/english/abstract-vol38/abstract/65.html>



<http://www.twi-global.com>

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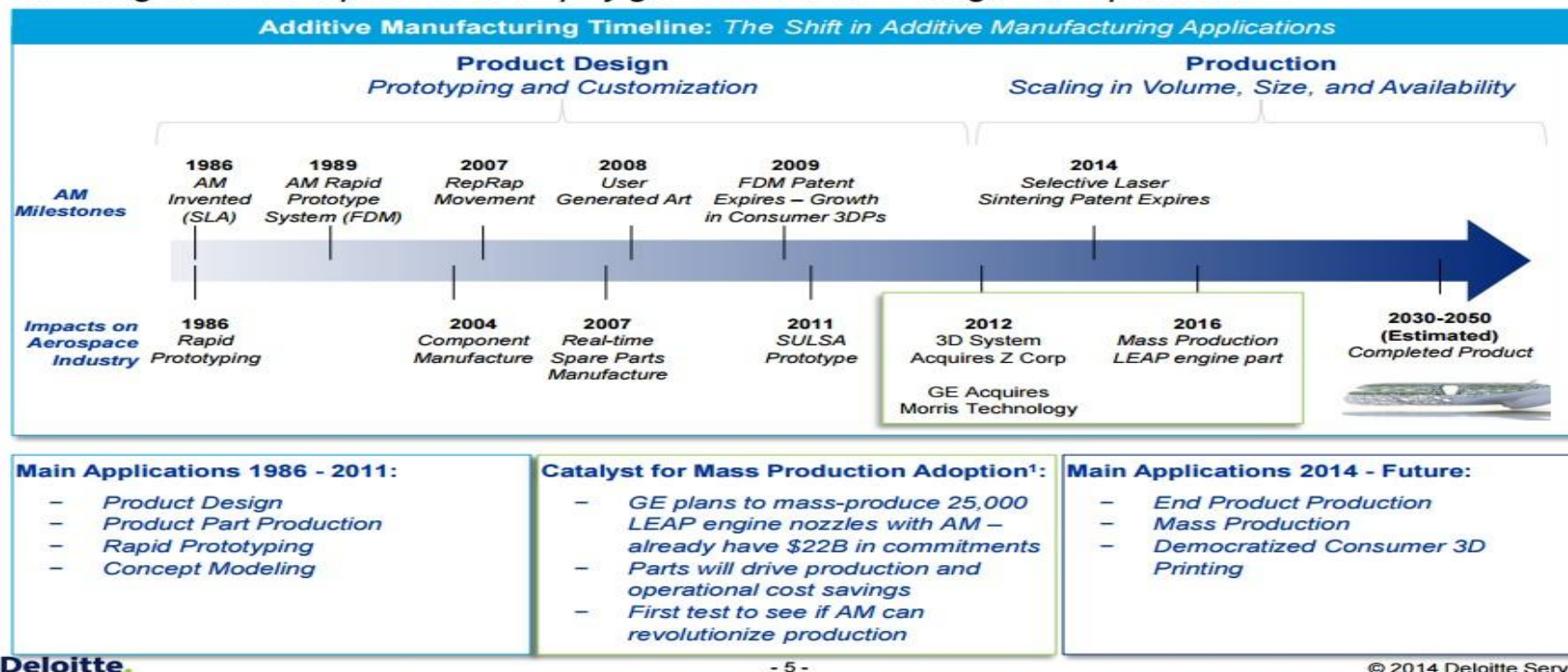
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Potential Path to Widespread Adoption

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Additive Manufacturing Adoption Timeline

Additive Manufacturing has been slowly gaining traction, specifically within design, however, new technologies have the potential to amplify growth and extend usage within production

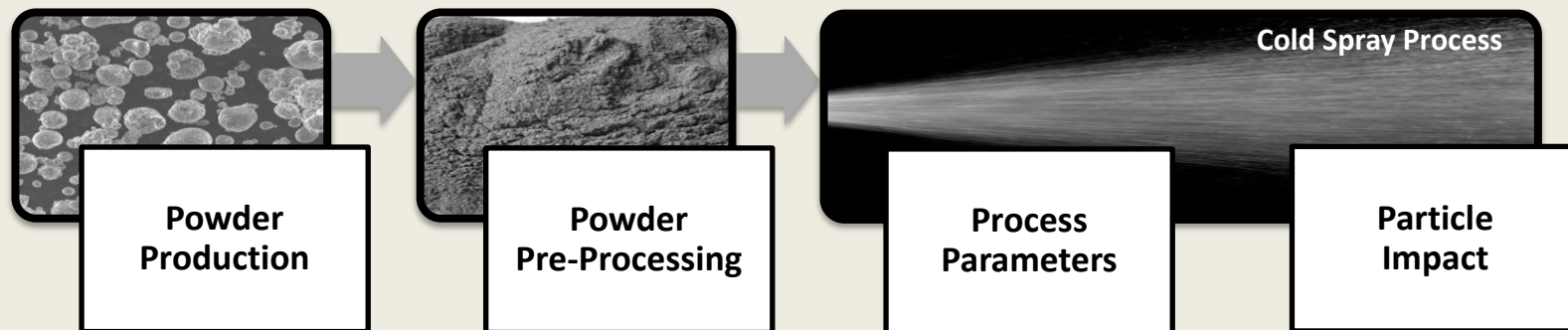
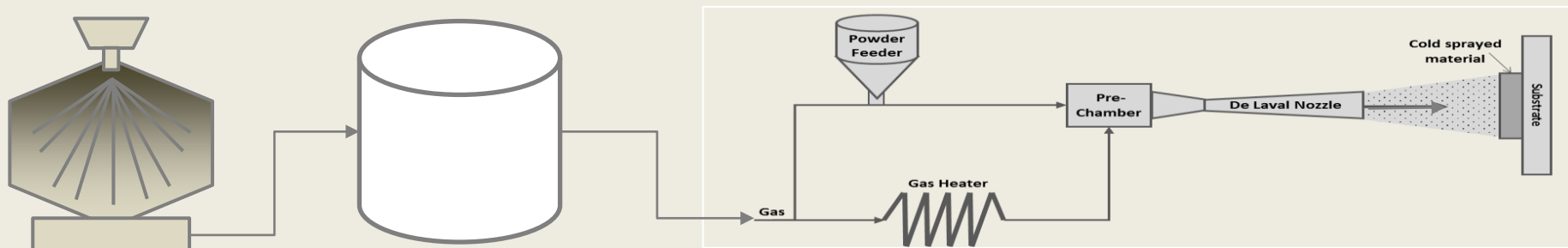


<http://www.forbes.com/sites/louiscolumbus/2015/03/31/2015-roundup-of-3d-printing-market-forecasts-and-estimates/>

- Feedstock Optimization
- Process Control
- Material Compatibility
- Safety
- Material Properties
- Reproducibility
- Qualification/Certification
- IP Strategy
- Cost Effectiveness

Cold Spray Research Transition to AM

- Feedstock Production Model
- Feedstock Characterization & Processing
- Thermomechanical Process Model
- Post-Process Requirements
- MSAT Materials Database



Courtesy of WPI

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Conclusion

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- **Dynamic AM Technology Landscape**
 - Diverse processes with unique opportunities & challenges
 - High corporate turnover & acquisition
 - Technology & component IP concerns
- **Material, Process, Structure, Performance Variation**
 - Multiple paths to optimization
 - Open research space requires focused efforts
 - Focus on high value added R&D

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