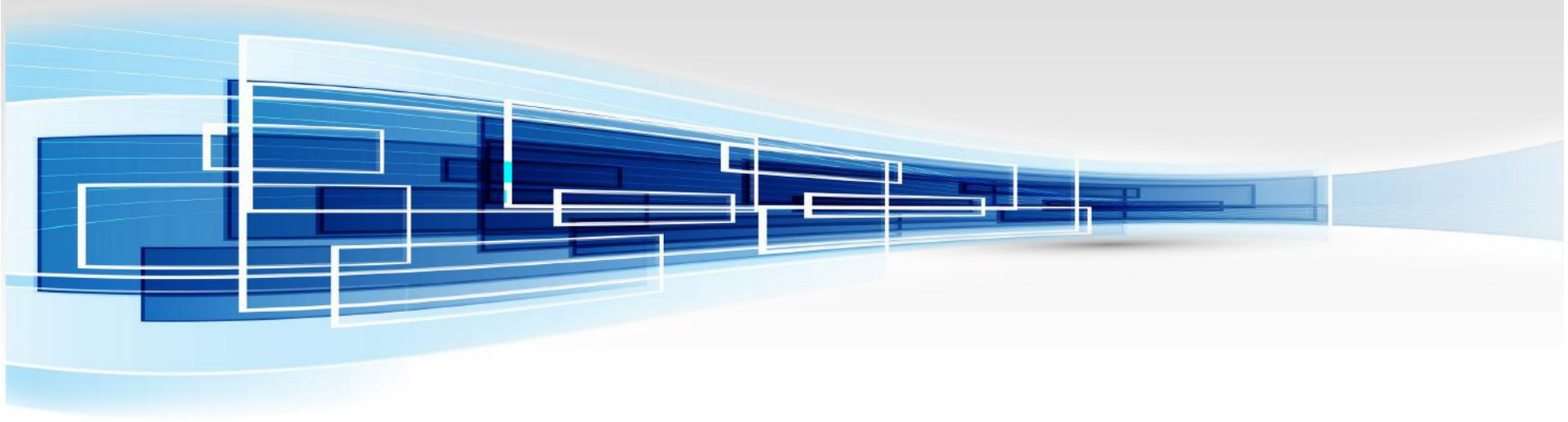
TOP TEN INDUSTRIAL ADDITIVE MANUFACTURING APPLICATIONS



OPTOMEC®

Production Grade 3D Printers... with a Material Difference

Top Ten Industrial AM Applications

1. Product Development of Functional Metal Parts
2. Hybrid Manufacturing Additive/Subtractive in One Machine Tool
3. Manufacturing Rework of New Metal Parts
4. Turbine Engine Component Repair
5. Remanufacturing of Obsolete Metal Components
6. Mass Production of 3D Conformal Antennas for Consumer Electronics
7. 3D Printed Electronics for Molded Interconnect Devices (MIDs)
8. 3D Printed Sensors for Internet of Things Applications
9. Printed Electronics for Semiconductor Packaging
10. 3D Printed Heater Circuits for Auto/Aero Applications

Product Development of Functional Metal Parts

- Reduces Time to First Part
- Reduces Material Costs > 90%
  - Typical parts have low material efficiency
  - Suspension mounting bracket 92% material loss
  - Drive shaft spider 97% material loss

Benefits: reduced time, cost & waste

Parts in Ti-6-4 and IN718 Courtesy: Red Bull Racing

Hybrid Manufacturing: Additive & Subtractive

Aerospace Metal Housing for Electronics

- Tough to cast, long lead time: 52 weeks
- Hybrid Manufacturing Strategy:
  - Base hub CNC machined
  - Thin wall details added by LENS process
  - Both process integrated in one CNC machine tool
- Delivery Time: 3 weeks
- Superior Design: reduced weight
- Design changes implemented during development

Benefits: 92% Time Savings & 30% Cost Reduction

Electronics Housing in 316SS, Courtesy: Sandia

Manufacturing Rework of New Metal Parts

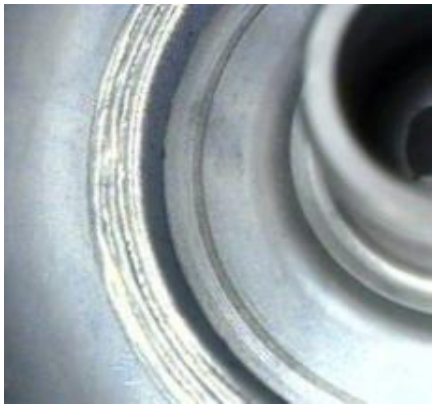
- Industry Need:
  - Reduce scrap from casting processes
  - Reduce scrap from machining defects
- Value Proposition:
  - Reduce scrap rate from 10% to ~0%
  - Reduce manual finishing compared to welding repairs
  - Improve on-time deliveries
- Solution:
  - LENS system from Optomec
  - Various metal powders

Benefits: reduced time, cost & waste

Turbine Engine Component Repair

Courtesy: Anniston Army Depot

After Machining



After Deposition

After Finishing

Repair Facts

- Material: IN718 Engine: AGT1500
- LENS Process Advantages: Properties, Low Heat Input, Near Net Shape
- In Production at Anniston Army Depot, $5M saved in first year

Benefits: $5M saved in first year

Remanufacturing of Obsolete Metal Components

Repair Details

- NAVAIR need: cost savings over replacement, repair of obsolete parts (no replacements available)
- NAVAIR alternatives: all conventional repairs unsatisfactory
- Materials of interest: Ti-6-4, IN718, stainless steel
- Feature types: blade tips, fastener wear, knife-edge seals
- Feature repair sizes: 0.010” to 0.050”

Benefits/LENS Advantage: Repair without damaging part

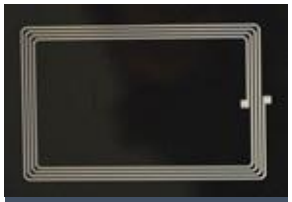
Mass Production of 3D Conformal Antennas

Market Driver

- Printed Antenna for SmartPhones/Tablets, Notebooks…
  - Main, Broadband, WiFi, Bluetooth, GPS, NFC, etc.
  - Printed Directly onto Standard Cases and Inserts
- *Benefits:*
  - *Eliminates Environmental/Health Issues with Plating/Nickel*
  - *Greater Design Flexibility Leading to Reduced Form Factors*
  - *Scalable For Mass Production*
  - *Lower Manufacturing Cost*

Mass Production of 3D Printed Antennas Courtesy of LiteOn Mobile

SmartPhone Main Antenna



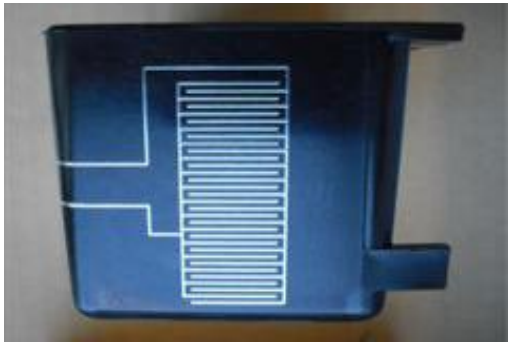
Near Field Antenna

Multiple Antenna on Case

Building WiFi

Printed Electronics for 3D MIDs

- Printed Electronics for 3D Molded Interconnect Devices
  - Sensors printed on ends of molded PA6 tank
  - Printed Ag circuits & printed conductive resin for solder free SMD component attach
  - Circuit Senses liquid fill level and reverses pump
- *Benefits/Advantages*
  - *Lighter Weight, Higher Performance*
  - *Simplified Electro-Mechanical Integration*
  - *Lower Cost*

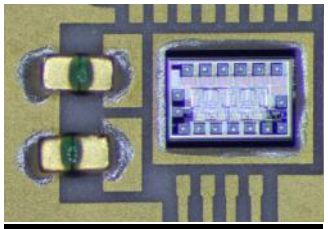


* Project Funded by: Bayerische Forschungsstiftung. Project Partners: Leoni Bordnetz-Systeme GmbH, Lüberg-Elektronik GmbH & Co./Neotech Services MTP/RF Plast GmbH Lehrstuhl/FAPS FAU Erlangen-Nürnberg/Fraunhofer IZM Mikro-Mechatronik-Zentrum/Georg-Simon-Ohm Hochschule Nürnberg

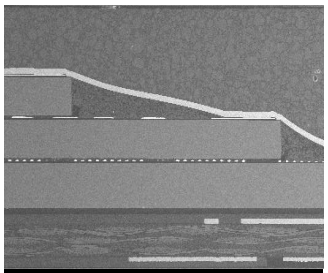
Printed Electronics for Semiconductor Packaging

Market Driver	Smaller Packages plus Improved Quality

- 2D and 3D Applications…
  - Direct Die / Component Attach for Rigid and Flex Applications
  - Component Underfill and Encapsulation
  - Embedded Passives
  - 3D Conformal Interconnects for Stacked Die & Other Complex Packaging Applications
  - Cost Effective Low Volume Manufacturing
- *Benefits: Lower Manufacturing Cost*
  - *Greater Design Flexibility Leading to Reduced Form Factors*
  - *Scalable manufacturing process from PCB to Die Attach*



Double ended Cap



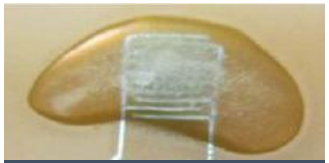
3D Stacked Die

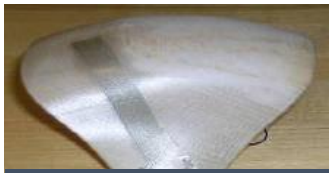
3D Printed Sensors for IoT Applications

Market Driver	Structural Health Monitoring for Internet of Things Applications

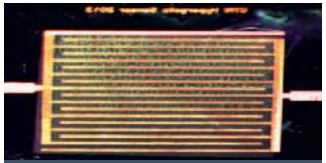
- Print many different sensor types; optical, electrical, bio
- Print in 2D or 3D, directly onto end use product
- High fidelity printing improves data resolution
- Digital Input allows mass customization / serialization

SAW Device 6um Features

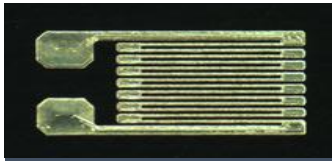

3D Interdigitated Ice Sensor

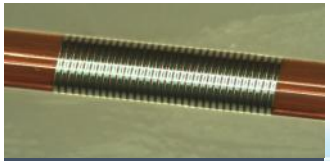

3D Strain Gauge

EMI Sensor Array


CNT-Based Gas Sensor

3D Creep Sensor


1mm Strain Gauge


3D Bio Sensor on Catheter

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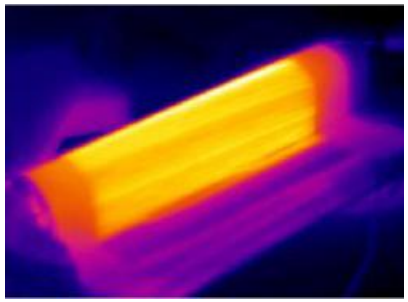
3D Printed Heater Circuits for Auto/Aero

Market Driver	Product Flexibility and Cost of Ownership

- Printed Heater Circuits for Automotive & Aerospace
  - Windscreens, Aircraft Wing Deicer, Seat Heaters…
  - Conformal printing of circuits directly on part surfaces
- *Benefits:*
  - *Digitally driven process enabling maximum design flexibility*
  - *Cost effective process for 3D substrates*
  - *Variable feature sizes & material thickness to meet heater resistance objectives*



Fully Printed Conformal Heater
Source: Qi2

For More Information Contact Us at

requestinfo@optomec.com

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