Multi-Material Additive Manufacturing: current status and future perspective Océ

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Outline

• Introduction
• Multi-Material Additive Manufacturing: Current Status
  • 3D Multi-Material Printing Canon
  • 3D Multi-Material Printing Océ
    • 2.5D Printing (Elevated Printing: Project Eiger)
    • MetalJet
    • Hotmelt Print Heads
• Multi-Material Additive Manufacturing: Future Perspective
  • Wish List Multi-Material AM
• Summary
Introduction: Océ 2D digital printers
3D Multi-Material Printing Canon

• Canon 3D printer

• Reselling 3DS printers
3D Multi-Material Printing Océ

• Océ Elevated Printing/Project Eiger
  • Commercially available print service
  • Verus Art
  • Reproducing material appearance shown at Canon EXPO 2015

• Océ MetalJet

• Océ Hotmelt Printheads
Project Eiger: Fine Art Reproduction

- (This links shows a 2 minute film on 3D fine-art scanning)
Project Eiger

- Océ Arizona Technology
Océ MetalJet: technology development

- Jetting of liquid metal drops by electrical current pulses
- Drops generated using Lorentz force

Critical design topics:
- High magnetic field
- High current pulses
- High temperature resistance
- Heating

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Magnetic flux concentrators
Core Technology

• Océ: Advanced Technology Development program
  • Jetting process
  • Improving performance

Applications

• Partners: Application Research Programs
  • Applications: 3D printing, electronics, photovoltaics, …
  • 1st ARP: with University of Nottingham on 3D printing

Business

• Printhead sales (consumables)
  • Licensing
MetalJet Application Research Programs:

**MetalJet printheads**
- knowledge, design, operation
- manufacture: strategic supplier relation
- *Océ: core asset*

**MetalJet equipment**
- External partner
- Generic & tailored to application
- *Océ: enabling*

**MetalJet applications**
- Pull: external interest
- External application development
- *Océ: support*
Océ Hotmelt printhead: component

- **Electrical path**
  - Printed circuit board with 4 ASICs and cooling fins
  - Flex
  - Actuator

- **Ink path**
  - Ink pearl
  - Melting unit
  - Filter unit
  - Ink reservoir
  - Channel block
  - Nozzle plate
Océ Hotmelt printhead is commercially available

- **Basic specifications**
  - 256 nozzles, 2 rows of 128 @ 75 npi per row
  - 18.7 kHz, 29 pl, 6 m/s
  - Ink viscosity range (6-12 mPa·s)
  - Operating temperature 130 °C (145 °C max)

- **Functionality**
  - PAINt nozzle status detection
  - Integrated ASICs for jet pulse generation
  - Internal ink reservoir with level sensor
  - Melting unit for solid inks
  - Scanning with 2g in print direction

- **Dimensions**
  - HxWxD = 152 x 155 x 20 mm
Performance Materials Digital Printing
Future Perspective: Personal Wish List
Multi-Material AM

- Improved Performance Materials
  - Wider range of performance materials: (jettable) support materials, engineering plastics, wide range of properties
  - Improved mechanical properties in z-direction
  - Improved sustainability/recyclability
  - Lower cost
  - ...

- Improved print technologies
  - Higher accuracy (z-direction, in-line process monitoring,..)
  - Higher productivity
  - Multiple deposition technologies combined
  - Lower cost
  - ...

- Improved print systems, applications & eco system
  - Improved workflow/reduced lead time
  - Improved CAD/CAE/CAM for AM: Declarative CAD
  - Improved end-to-end quality and consistency
  - Improved eco-system/networks/open innovation
  - ...

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Summary/Conclusions

• Multi-Materials Printing is at the Core of our Technology
  • Material Jetting (ink jet)
  • Moving from 2D via 2.5D to 3D digital AM

• Materials Performance/Quality aspects are key in AM:
  • Enhanced Performance
  • Improved Sustainability
  • Lower Cost
  • Higher Productivity
  • Higher Accuracy

• A long wish list
  • Improved Materials
  • Improved Print Technology
  • Improved Print Systems, Applications
Back up slides
Performance Materials Digital Printing

### Introduction: Océ

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
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<tbody>
<tr>
<td>1877</td>
<td>Lodewijk van der Grinten develops new coloring agent for margarine</td>
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<tr>
<td>1927</td>
<td>New ammonia-free blueprint process</td>
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<td>1970</td>
<td>First Océ plain paper copier</td>
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<td>2013</td>
<td>Océ fully integrated into Canon</td>
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Multi-Material AM @Océ

- Deposition technology: Material Jetting
  - Piezo Ink Jet
  - MetalJet

- Materials: polymers (inks), metals
  - UV curable acrylate inks
  - UV gelling acrylate inks
  - Water based inks
  - Hotmelt inks (thermal curing)
  - …

- Projects
  - Project Eiger (2.5D printing, Fine Art Scanning and Reproduction)
  - MetalJet (Application Research Program)
  - Hotmelt printhead
3D Printing Océ

- 2D digital printing (= Additive Manufacturing!)
- Inks = Multi-Materials
- Ink jet = a Multi-Material AM Deposition Technology
- From 2D to 2.5D to 3D digital printing
- Enhancing the “ink” print materials: polymeric, metallic, …. 

- Several roles in AM:
  - End-user
  - Service provider
  - Technology Developer
  - Systems/components supplier
  - Reseller
  - …
Print Technology: Piezo Ink Jet

- Source: http://www.imaging.org/ist/resources/tutorials/inkjet_printer.cfm
Project Eiger/2.5D printing

Project Eiger

- Elevated printing using multiple layers of UV ink printed with patented software and hardware based on the Océ VarioDot technology

- Heights up to 5mm

- Use of standard substrates with different thickness (but opportunity to extend)
  - Di-bond
  - Acrylic (plexi)
  - Gator foam board

- Key strengths technology:
  - High resolution printing
  - Full CMYK + white color spectrum
  - Large size (up to 2.4 x 1.2 meter)
  - Tactile
  - Patented
Project Eiger Technology

The technology explained: Stacking layers of ink

- A unique and patented print technology to deposit hundreds of layers of ink on top of each other. Result is full process color and very high accuracy.
Project Eiger vs 3D printing

How Project Eiger relates to 3D printing

- Limited use of color, less sharp
- Material is low in resolution

+ very high resolution
+ full color print

3D print

Project Eiger
Project Eiger Examples

A few examples

- Up to 2.4m wide
- Fine details
- Tactile
- Full color
3D Printing in Océ & Canon

- MetalJet

- Océ Elevated Printing
  - Commercially available print service
  - Verus Art
  - Reproducing material appearance shown at Canon EXPO 2015
Jetting and direct deposition of droplets of pure metals, alloys or semiconductors (from the melt), at high temperatures

- Research project started in 2006
- Clear advantages over competing technologies (application dependent)
- Multiple applications anticipated and identified

- Ag
- Sn
- Au
- Cu
- Si
- ...
Océ metaljet: technology

MetalJet printheads: developed for integration in industrial printers

Jetting process knowledge

- Molten metal “droplets in flight”
- Heated cartridge (1000-1800°C) inside printhead module
3D Printing Market: Gartner hype cycle

Source: Gartner (July 2015)
Multi-Materials Digital Printing

UV-hardening Acrylate Chemistry

Print Technology
Print System
Application
Performance
Material
UV-hardening Acrylate Chemistry