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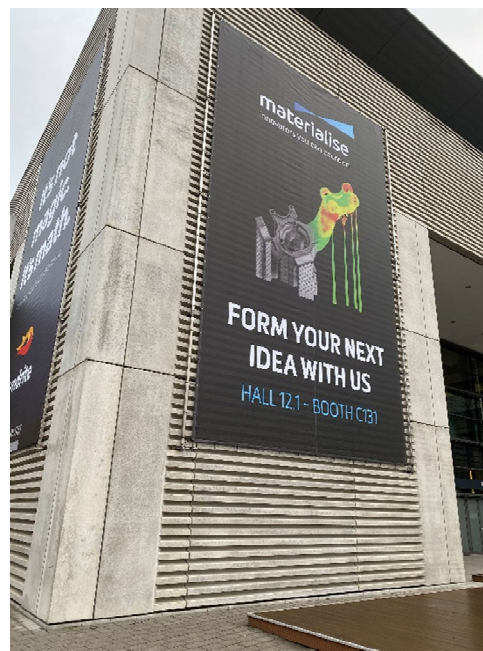
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特集1 金属造形の進歩

金属造形は、航空宇宙分野、医療分野などで、実製品製造への活用が始まり、自動化、品質維持、さらに効率的な生産方法に各メーカーの開発が進んでいる。

2019年は以下のポイントで各社の動向をまとめた。

- 1) BJT方式による金属造形は、どこまで来たか
- 2) 自動化とプロセスモニタリング
- 3) 気になった材料

1) BJT方式による金属造形は、どこまで来たか

金属パウダー層にIJ技術をもちいてバインダーを噴射し、グリーンパーツを作成する技術はExOneが以前から手掛けていたが、Desktop Metalが大量生産装置として大々的に発表して以来、各社の注目を集め、いまやHP、GE、Stratasysなど造形装置大手も開発を進めている。



特集2 樹脂造形の進化と広がり

1) 大量生産

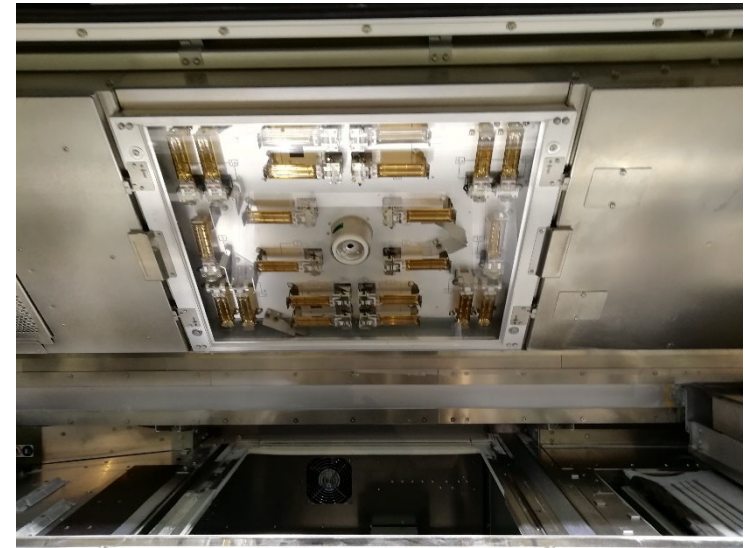
HP Jet Fusionの登場

造形速度 約5リットル／Hr

品質保証のために、多数のセンサーを導入しプロセスをコントロールしている

特に温度制御が重要

工場に複数台を設置することを想定し、排気量のばらつきによる条件の揺らぎを減らすため、排気ダンパーも設置されている。



EOS LaserProFusion (2021年以降)

100万本のレーザーを使い、高速造形

5cmレベルの部品であれば9秒で造形



特集3 セラミック造形の広がり

セラミックスの3D造形は、大きく分けて2つの方式がある

- 1) UV樹脂にセラミックス粒子を分散し、VPP方式やDLP方式で造形した後、焼結を行う

3DCeram、Lithoz、Admatecなど

- 2) サブミクロン粒子を分散させた液体をIJ方式で造形（着弾時に溶媒は飛散し3D形状ができる）

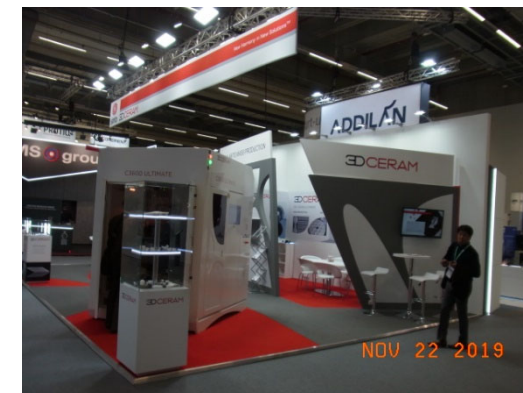
X-jet



展示各メーカーの動向

3DCERAM

主たる展示分野	VPPによるセラミック造形
出展社概要	フランス発のセラミック造形装置メーカー。現在は日本の新東工業傘下にある。
ビジネストピックス	大型のセラミック造形機のアピール
展示された技術トピックス	大型造形機 C3600 Ultimate 各種応用例(エネルギー産業、宇宙産業など)
昨年からの進歩点	大型造形装置の登場
競合に対する優位点	装置とともに、各種特性を持つ材料を提供
自動化への動き	
品質保証への取り組み	
応用分野、アプリケーション	高温を必要とする産業:エネルギー産業、半導体産業 宇宙産業:光学機器のベース(熱膨張が少ない) バイオ:代用骨



装置名	C3600 Ultimate
製品カテゴリー	造形装置
発売時期	新製品
造形方式	VPP
造形材料(代表的なもの)	AIN、ジルコニア、アルミナ、窒化シリコン、シリカなど
造形サイズ	600 × 600 × 300mm
特徴、優位点	大きな造形エリアを持つ
標準価格(\$US)	€100K



formnext 2019

コンファレンス編

展示会の最中にも並行して、さまざまな**Conference**が開かれている。

日程

**11月19日 Keynote Speech
Conference**

**11月20日 Keynote Speech
Conference**

**11月21日 Keynote Speech
Conference**

**11月22日 Keynote Speech
Conference**

Conference Program(11/19)

2019/11/19					
ST	END	speaker	Theme	speaker	Theme
		Key note			
10:00	10:30	Maximilian Meixlsperger Head of Additive Manufacturing Metal BMW Group	Additive Manufacturing in Industrial Production		
10:30	11:00	Andreas Henneberg Specialist New Manufacturing Technology, Research Cabin Diehl Aviation	The Potential of Additive Manufacturing for the Aircraft Cabin		
		Transportation		Business and Economic Consideration	
11:15	11:45	Waldemar Hirsch Coordinator Additive Manufacturing Audi Sport GmbH	AM Rollout for Audi Sport and Next Level of Design Automation	Chris Connery VP Global Analysis Context	2019 3D Printing Market Sizing and Forecasting
11:45	12:15	David Maass President Flightware	Demonstration of Closed Loop Inspection and Repair Using Layer Topographic Mapping with L-PBF	Eric Barnes Fellow Northrop Grumman	Approach for Additive Manufacturing Development and Implementation at Northrop Grumman
13:15	13:45	Lionel Kiener Expert CSEM	Innovative Concept for Additive Manufacturing of Compliant Mechanisms	Matthias Schneck Research Assistant Fraunhofer Research Institution for Casting, Composite and Processing Technology IGCV	Training in Additive Manufacturing
13:45	14:15			Dr Wilderich Heising Partner The Boston Consulting Group	Surviving Disruption in Additive Manufacturing - Choosing the "Best" Technology
14:30	15:00			Klaus Brisch Partner and Global Head of Technology DWF	Legal Implications of Technical Standards – Core Proceedings
15:00	15:30	Bastien Atger R&T Pilot Seats Project Leader STELIA Aerospace Jean-Baptiste Devillers R&T Metallic Parts & Additive Manufacturing Project Leader STELIA Aerospace	Development of a Design-to-Print Philosophy Focused on Economical Efficiency	Gerhard Gleich Managing Director and Head of Germany Stephens Europe Valentin Zur Strassen Analyst Stephens Europe	Competing Business Models and Strategies in Additive Manufacturing
15:30	16:00	André Bialoscek Head of Vehicle Physical Integration Hennigsdorf Bombardier	How the Rail Industry Can Benefit from Additive Manufacturing	Stavros Tsitsopoulos Technical Lead - Additive Manufacturing HSSMI - A Manufacturing Innovation Institute	Up-Scaling AM for End-Use Components

参加セミナー

Conference Program(11/20)

2019/11/20

ST	END	Theme	speaker	Theme	speaker
10:00	11:00	Phil DeSimone Chief Customer Officer Carbon Inc	The Future of Product Innovation: How Companies are Using Digital Manufacturing to Make Breakthrough Products - Sponsored by Carbon Inc		
		Health		MAP	
11:15	11:45	Carsten Moenicke Hub Development Manager Digital Fabrication and Personalized O&P Ottobock SE & Co. KgaA	Orthopedic Technology (O&P) 4.0: Hand Craft Meets Hightech	Sabine Bodner PhD Student Montanuniversität Leoben	Dispersion-Based Inconel-Steel Hybrid Characterized by Cross-Sectional Micro X-Ray Diffraction
11:45	12:15	Cemile Basgul PhD Candidate Drexel University	Comparison of Different FFF PEEK Printer Generations and Nozzle Sizes for FFF Printed PEEK Spinal Cages	Carlo Burkhardt Scientific Director Institute for Precious and Technology Metals, Pforzheim University	Advances in High Precision Lithographic Additive Manufacturing with Stainless Steel and Titanium Alloys
13:15	13:45	Serafin Garcia Navarro Head of Design and Injection Moulding Department AIMPLAS	3D Printing in Healthcare; It's Not a Sci-Fi Issue; It's Reality Now	Research Engineer in Fusion Welding MTC - The Manufacturing Technology Centre	The Present State and Future Prospects of Large Scale Aluminum Additive Manufacture
13:45	2:15	Tatjana Popovic Independent Expert Associate and Mechanical Engineer in Design and Manufacture Department Hemofarm STADA	Additive Manufacturing of Spare and Format Parts - Design and Performance Improvement	Benedikt Blitz Partner and Managing Director SMR Premium GmbH	Update on Forged Special Steels, Remelting and Powder Metallurgy
14:30	15:00	Dr Mohsen Seifi Director of Global Additive Manufacturing Programs ASTM	Additive Manufacturing Standardization in the Healthcare Industry	Geoffroy Lumay Associate Professor University of Liege	Combining Powder Characterization Methods and Numerical Simulations to Optimize Printing Parameters
15:00	15:30	Stephan Kreimer Master Dental Technician Kreimer Dentallabor GmbH & Co. KG	Growing Your Dental Business with 3D Printing	Gerret Lukas Group Lead Additive Manufacturing Systems at the Machine Tool Laboratory (WZL) RWTH Aachen University	Analysis and Optimization of the Direct Polymer Additive Tooling Process Chain for the Production of Complex Geometries
15:30	16:00	Alex Kingsbury Industry Fellow - Additive Manufacturing RMIT University	Global Adoption of Patient-Specific Implants - Research that Addresses the Challenges	Marc Crescenti Senior R&D Engineer Eurecat	CFIP Technology: A New Approach for Manufacturing Continuous Carbon Fibre Reinforced Structures by 3D Printing

参加セミナー

Conference Program(11/21)

2019/11/21					
ST	END	Theme	speaker	Theme	speaker
10:00	10:30	Franziska Kaut Process Engineer Polymer Technology P&G - Procter & Gamble	Industrial Challenges of Polymer AM Multicomponent Part Production at P&G Devices		
10:30	11:00	Todd Grimm Founder and President T. A. Grimm & Associates	An AM Checklist: Separating the Wheat from the Chaff when Buying AM Equipment		
		Industrial Challenge		Applied Research	
11:15	11:45	Erik Marquardt Technology and Society VDI e.V - The Association of German Engineers	The VDI Contribution to International AM Standards	Cheng-Tse (Eric) Wu PHD Student University of Toronto	NiTa Alloy Sputtering Target Built by Selected Laser Melting for Hard Disc Applications
11:45	12:15	Dr Jürgen Bischoff Member of the Executive Board Agiplan Stuttgart Friedrich Bähr Additive Manufacturing Expert Agiplan Stuttgart	The Additive Manufacturing Factory of the Future	Philipp Stoll Scientific Assistant Inspire AG icams	Sensor Integration in Plastic and Metal AM Parts Based on Two Industrial Use Cases
13:15	13:45	Oliver Fletcher Additive Mfg. Qualification & EU Application Specialist Eaton	Qualification of Additive Components for Aerospace Industry	Balthasar Fisher CEO XARION Laser Acoustics GmbH	Analyzing AM's Ultrasound Emission to Monitor Manufacturing Stability
13:45	14:15	Maciej Tusz President and CEO Magnitude Innovations Inc	Metal AM Total Cost of Ownership and Risk Mitigation through Operational Excellence	Pascal Becker Research Scientist FZI Forschungszentrum Informatik	Usage of Service Robotics in Additive Manufacturing
14:30	15:00	Marcus Schindler Head of Materials Management Gerhard Schubert GmbH	Printing Functional End Parts for Packaging Lines to Increase Uptime and Faster Time to Market	Quentin Massard Additive Manufacturing Engineer and PhD Student ENISE - École Nationale d'Ingénieurs de Saint-Étienne	Processability Study and Parametric Optimization of 100Cr6 Steel Produced by Laser Powder Bed Fusion
15:00	15:30	Anne Rathje Additive Manufacturing Process Engineer Baker Hughes, a GE company	AI Quality Control – Build Job Monitoring with Near-Net-Shape Specimens	Christian Tenbrock Head of Team Machine Technology - Laser Powder Bed Fusion Fraunhofer Institute for Laser Technology	Scalable Machine Concept for Laser Powder Bed Fusion
15:30	16:00	Tom Mueller President Mueller AMS	Evaluation of a Low-Cost Material Extrusion Printer for Investment Casting Applications	Marcus Bugbee Head of Media Acquisition and Deputy Head SMZ Stuttgart	Experiencing 3D: Integrating New Technologies in Education

参加セミナー

Conference Program(11/22)

2019/11/22				
ST	END	Session	Theme	speaker
10:00	10:30	Key	Pia Gausemeier Head of Strategic Production Technology and Head of Information Technology - Plant Bielefeld Miele & Cie	3D Printing at Miele
10:30	11:00	Key	Mark Chisnell Technology Coordinator INEOS TEAM UK	Race to Innovate: Metal Additive Manufacturing for Lightweight, Highly Complex Race Boat Structures
11:15	11:45	Design and Innovation	Dr Holger Strauss Facade Specialist, Architect and Co-Founder Lithium Architects	Design and Engineering of Complex Building Envelopes
11:45	12:15	DIA	Andrew Triantaphyllou Technical Specialist, ATFE Group MTC - The Manufacturing Technology Centre	Designers' Huge Role in the Uptake of AM
13:15	13:45	DIA	Keun Park Professor Seoul National University of Science and Technology	Design and Analysis of 3D Conformal Lightweight Structures Based on Finite Element Mesh
13:45	14:15	DIA	Kees Van IJselmuiden Structural Design Manager and Manager Digital Engineering Royal HaskoningDHV	3D Printing of Structural Pedestrian Bridges

参加セミナー

今回参加したセミナー

日時	タイトル	講演者	所属
11月19日	10:00 ①Additive Manufacturing in Industrial Production	Maximilian Meixlsperger	BMW Group
	11:45 ⑧Demonstration of Closed Loop Inspection and Repair Using Layer Topographic Mapping	David Maass	Flighware
	②2019 3D Printing Market Sizing and Forecasting	Chris Connery	Global Analysis and Research
	13:45 ③Surviving Disruption in Additive Manufacturing - Choosing the “Best” Technology	Dr Wilderich Heising	The Boston Consulting Group
	14:30 ④Legal Implications of Technical Standards Core Proceed	Klaus Brisch	DWF
	15:30 ⑦How the Rail Industry can Benefit from AM	Andre Bialoscek	Bombardier
11月20日	10:00 ⑨Cracking the Code : Digital Manufacturing at Scale	Philip Desimone Garrett Getter	Carbon Specialized Bicycle Components
	11:45 ⑩Advanced in High Precision Lithographic AM with Stainless Steel and Titanium Alloys	Carlo Burkhardt	Pforzheim University
	15:30 ⑪CFIP Technology:A New Approach for Manufacturing Continuous Carbon Fibre Reinforced Structures by 3D Printing	Mark Cresenti	Eurecat
11月22日	10:00 ⑤3D Printing at Miele	Pia Gausemeier	Miele & Cie
	13:15 ⑥Design and Analysis of 3D Conformal Lightweight Structures Based on Finite Element Mesh	Keun Park	Seoul National University

① Additive Manufacturing in Industrial Production

日時 2019年11月19日 Speaker Maximilian Meixlsperger : BMW Group

BMWグループによるAM生産の現状と今後の課題について

1. **AM**は将来ビジョンではなく、**BMWグループ**では既に生産で活用されている。
2. さらに普及するにはコスト制約の問題がある。
3. また、普及には、標準・共通のインターフェースが必要である。



先進研究施設 調査報告

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① European 4.0 Transformation Center (E4TC)

訪問日 2019年11月25日 10:00-12:00

面談者 Dr. Jan Wilhelm (Plaxisforum Online Education Leader)

E4TCについて

Aachen郊外にはAachen工科大学、Fraunhofer研究所、関連する研究機関が多数集まったエリアがあり、組織の枠を超えた共通技術のクラスターを形成して技術開発、新規ビジネスの開発を行っている。Aachen地区には7万人近い学生がおり、彼らの若いアイデアを活用して新しいものを作り出す気風が強い。

E4TCは、アジャイルな開発(実際にモノを作るところも含め)で、スピード感をもって新規ビジネスをスタートすることを目指しており、現在はe GOという小型の電気自動車を製品化し、販売している。

ネットワークの広さがこのエリアでは重要。

