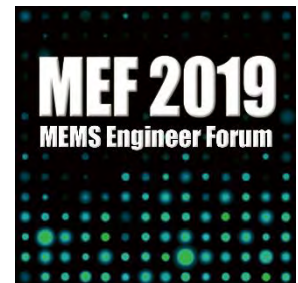


**The 11th
MEMS
Engineer Forum (MEF)
2019
SMART Society Driven by MEMS**



April 24-25, 2019

KFC Hall

Ryogoku, Tokyo

Welcome to MEMS Engineer Forum 2019

SMART Society Driven by MEMS

MEMS Engineer Forum is a unique place mainly gathering engineers related to MEMS technology, which is the vital key for the 21st century. We strongly believe that the key players in this field will drive the world in diversified business sectors over the next decades. Since the start of the 1st MEF in March 2009, this forum has been held annually with MEMS researchers, developers, engineers gathering in one place. We are very pleased to have the opportunity to hold the 11th annual MEF 2019.

The worldwide fusion and creation of the new movement based on MEMS fundamental, application, and interdisciplinary technology field as well as MEMS markets will be followed up by MEMS engineers via excellent vision and skills in the forum.

MEMS Engineer Forum (MEF)は、21世紀のキーテクノロジーとされるMEMS技術の現状と、向こう10年までの技術の将来に迫る、この分野のキープレイヤーの中でもエンジニアを中心に運営されるユニークな場です。世界中のMEMS研究者、開発者、技術者が一堂に集うこのフォーラムは、2009年3月の初開催以降、回を重ね、MEF2019で第11回を迎えることとなります。MEFは、MEMSに関する基礎技術ならびに隣接分野の技術において、エンジニアならではの視点と技量で、新しいカタチを形成し、そして融合させて参ります。さらに融合の過程や完成に向かう姿を国際的なレベルで検証することをミッションとしております。

第11回MEMS Engineer Forumは、2019年4月24日(水)～25日(木)、東京 両国のKFCホールで開催されます。MEMS関連のエンジニアが世界から集まり、技術やビジネスの未来を語るユニークなグローバルミーティングです。講演セッション、技術展示、出展者プレゼンテーション、ネットワーキングレセプションなど、すべての機会を通して、技術ならびに事業展開の拡大の議論を深めて頂けますことを願っております。

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敬称略 ABC 順

MEF International Advisory Committee

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	WeiLeun Fang	National Tsing Hua University
	Udo-Martin Gomez	Robert Bosch
	Lorenz Granrath	National Institute of Advanced Industrial Science and Technology (AIST)
	Thomas Kenny	Stanford University
	Xinxin Li	Shanghai Institute of Microsystem and Information Technology
	Hiroshi Miyajima	Goertek Technology Japan
	Yutaka Nonomura	Meijo University
	Kurt Petersen	Silicon Valley Band of Angels

Welcome to the 11th MEF

MEF 2019 組織委員長/東北大学 教授 田中 秀治
Shuji Tanaka, MEF Organizing Committee Chair

Welcome to 11th MEMS Engineer Forum (MEF). I am very happy to hold MEF 2019 with great contributions and kind supports by many speakers, companies, committee members and many other peoples. MEF has been very successful in the past 10 years as one of the best business development conferences in MEMS field under strong leadership by Prof. Hiroki Kuwano (Chair), Mr. Susumu Kaminaga (Vice Chair), Prof. Masayoshi Esashi (Vice Chair) and Prof. Naoto Kobayashi (Vice Chair).



To open the next 10 years' door, I have taken over Chair position from this year's MEF as the next generation and newly organized the committee. We will make our best to further develop MEF and make MEF more valuable for MEMS-related industry. It is reassuring for me and new committee members that the past Chair, Vice Chairs and committee members kindly help us as International Advisory Committee. Actually, MEF 2019 has been prepared by both committees.

MEMS industry is continuously showing healthy growth. Traditional and exiting devices are technologically developing and increasing applications in AI, IoT, 5G, automated driving, robotics, VR/AR etc. In addition, new devices and applications are continuously being created by startups in the world. MEF 2019 will cover both of these dynamics in the MEMS field. I hope all attendees fully enjoy MEF 2019 and find valuable information, hints and networks.

Finally, I would like to deliver my sincere acknowledgement to our sponsors and exhibitors. MEF is never successful or even cannot be held without their supports. Thank you.

第11回 MEMS Engineer Forum (MEF) にご参加を頂きまして有難うございます。昨年、10周年を迎えた MEF は、10年間、桑野博喜委員長（東北大学）、神永晋氏副委員長（SPP テクノロジーズ）、江刺正喜副委員長（東北大学）、小林直人副委員長（早稲田大学）のリーダーシップのもと、世界で最も充実した MEMS 関係のビジネスディベロップメント会議になりました。本年、11年目を迎えるにあたり、私が組織委員会の委員長を拝命致しました。若輩者ではございますが、ここまで MEF を盛り上げてこられた諸先輩方に International Advisory Committee としてご助言・ご助力を頂きつつ、新生組織委員会のメンバーとともに、MEF の次の 10 年を切り拓いていきたいと思っております。引き続き、MEF をよろしくお願い致します。

●今年の見どころ

MEMS 分野では、産業として確立したデバイス群が技術的にもビジネス的にも健全に成長を続けるとともに、スタートアップなどを通じてあらたな産業の種が次々として登場しています。これまでと同じように、今年の MEF でも MEMS 分野におけるこれら両方のダイナミズムをカバーします。

現在、最大のビジネスサイズを有し、同時に高い成長率を示しているデバイスは、BAW (bulk acoustic wave) フィルタです。スマートフォンで提供されるサービス群が我々の生活をどんどんと便利にしていることは、日々、実感される通りですが、無線通信に必須の周波数選択希望を担っているのが BAW フィルタです。IoT でも 5G でもポスト 5G でも、BAW フィルタの重要性は益々高まっています。今年は、Qorvo の Robert Aigner 氏に BAW フィルタの講演をして頂きます。

MEMS 業界のジャイアントである Robert Bosch からは Bosch プロセスの生みの親である Franz Laermer 氏と Georg Bischopink 氏に、STMicroelectronics からは Davide Bruno 氏にご登壇頂きます。日本最大の MEMS メーカーである TDK には、同社の MEMS ビジネスについて組織委員でもある飯田淳氏から大いに語って頂けると思っております。ローム、村田製作所、Leti などの MEMS 業界の主要プレーヤーからの話題提供も楽しみです。

あらたなデバイスとアプリケーションを生み出す上で、スタートアップの役割はとても重要です。今年
は選りすぐりのスタートアップを招待しています。MEMS スピーカの USound、超音波レンジファイン
ダの Chirp Microsystem、マイクロミラーデバイスの Blickfeld と UltiMEMS、これらの注目スタート
アップご講演は、おそらく日本では MEF 以外ではなかなか聞くことができません。さらに、MEMS 分野
のスタートアップを俯瞰したご講演を、今年も MEMS 業界の重鎮である Kurt Petersen 氏にして頂き
ますが、今年の MEF を通じて最も注目すべきご講演の 1 つになると思います。

●MEMS を中心としたサプライチェーンもカバー

MEF にご招待しているのは、MEMS メーカーからの講演ではありません。材料、ツール、ファウ
ンドリなどのサプライチェーン全体から、魅力的なご講演があります。今年は、盛り上がりつつある圧電
MEMS のキーとなる圧電材料に注目し、AIN 系材料の大手ツールメーカーである SPTS Technologies、お
よび PZT を得意とするファウンドリであるロームとシリコンセンシングプロダクツにご講演をお願いし
ています。Qorvo、TDK、村田製作所、Leti などのご講演と一緒に聞いて頂けると、昨今の圧電 MEMS
の盛り上がりが浮かび上がるだろうと思います。

また、参加者に視野を広げて頂き、次のビジネスチャンスのヒントを掴んで頂くため、周辺技術のご講
演も取り揃えています。理研の小寺秀俊先生、東京大学の松永行子先生、同じく東京大学の高井まどか先
生には、ナノ・マイクロ技術とバイオ技術の接点について新しい視点を提供頂けると思います。また、北
海道大学の宮下和士先生にはバイオリソングシステムについてご講演頂く予定です。

●産業界全体で盛り上げるイベント

MEF は、参加したいと思った方、特に若手が参加しやすいように、入場料を無料にしています。MEF
の企画は組織委員会と International Advisory Committee の各委員のボランティア活動に支えられ、
ご講演者には各委員との人的つながりによってやはりボランティアでお越し頂いています。また、運営
費はスポンサーシップと出展料によって賄われています。おおよそ 40 社・機関からのご出展は、ご講演
と並び MEF のもう 1 つの魅力であり、出展の場でのネットワーキングは、参加者にとって MEF での最
大の成果と言えると思います。つまり、MEF は、MEMS に関連する産業界の皆様のご貢献によって盛り
上がるフォーラムなのです。毎年、多くの企業様にスポンサーシップと出展でお世話になっておりま
すが、今年も多くの企業様にご支援を賜りましたことをこの場を借りて厚く御礼申し上げます。

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Committee gratefully acknowledges
the following companies for their support.

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ULVAC, Inc.

MEF 2019 EXHIBITORS

MEMS Engineer Forum 2019 Organizing Committee and International Advisory Committee gratefully acknowledges the following companies for their excellent technology exhibits.

<五十音順>

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4 大学ナノ・マイクロファブ리케이션コンソーシアム
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<Alphabetical Order>

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MEF2019 プログラム

2019年4月24日(水)

- 8:45- 8:50 開催のご挨拶
田中 秀治 氏
MEF 組織委員長/東北大学 大学院工学研究科 ロボティクス専攻 教授
- 8:50- 9:00 MEF 2019 の概要
野副 真理氏
MEF 組織副委員長/株式会社日立ハイテクノロジーズ
- バイオテクノロジーと MEMS の接点 (セッションチェア: MEF 組織副委員長 東京大学 三宅 亮氏)
- 9:00-9:40 キーノートアドレス
バイオ MEMS の歴史と将来
小寺 秀俊氏
国立研究開発法人理化学研究所 理事
- 9:40-10:05 血管機能評価のための微小血管チップ
松永 行子氏
東京大学 生産技術研究所 大学院工学系研究科バイオエンジニアリング専攻 准教授
- 10:05-10:30 バイオセンサー、バイオデバイスにおける生体分子の吸着が引き起こすノイズの
低減のための界面創製
高井 まどか氏
東京大学 大学院工学系研究科 教授
- 10:30-11:25 休憩時間/併設展示
- MEMS のメインストリーム (セッションチェア: 立命館大学 安藤 妙子氏)
- 11:25-11:50 Generic MEMS and NEMS Platforms for a wide variety of sensors
Dr. Jean-Philippe Polizzi
Micro and Nano-systems Program Manager
CEA Leti
- 11:50-12:15 MEMS Sensors for Automotive Safety and for Automated Driving
Dr. Georg Bischofink
Vice President, Automotive Sensor Development
Robert Bosch GmbH
- 出展者プレゼンテーション Part I (出展者 5分ずつ、下記順に行われます)
- 12:15-12:55 (セッションチェア: 東北大学 大高 剛一氏)
- Coventor, A Lam Research Company
Coventor, A Lam Research Company 木下 好之氏
Application of Xperi Direct Bonding in MEMS
Xperi, Abul Nuruzzaman 氏
MEMS 用設計ツール IntelliSuite ver9.0 と Total MEMS Solution(TM)の紹介
株式会社 アドバンステクノロジー、平出 隆一氏
5G とスマート社会を可能にするアルバックの MEMS 技術
ULVAC 河合 智史氏

Lighting Edge Technology for MEMS

ウシオ電機株式会社 栗田 朋美氏
トリリオン・センサ社会に向けた SPT の加工装置群
SPP テクノロジーズ株式会社 金尾 寛人氏

12:55-13:35 昼食時間／併設展示会コアタイム

●周波数制御デバイス (セッションチェア：株式会社デンソー 川原 伸章氏)

13:40-14:15 キーノートアドレス
BAW Technology: Finding the \$in RF-MEM\$
Mr. Robert Aigner
Senior Director of Acoustic Devices R&D, Qorvo Inc.

14:15-14:40 世界最小 32.768 kHz MEMS 振動子
後藤 雄一氏
株式会社村田製作所 タイミングデバイス商品開発部マネージャー

14:40-15:05 Advances in doped AlN deposition techniques for next generation Piezo-MEMS
Dr. Anthony Barker
PVD Product Manager, SPTS Technologies Ltd.

●出展者プレゼンテーション Part II (出展者 5分ずつ、下記順に行われます)

15:05-16:05 (セッションチェア：東北大学 大高 剛一氏)

ソフトマテリアルを使用した触覚フィルム
株式会社オーギャ 水島 昌徳氏
協同インターナショナル & Silex Microsystems の MEMS ファンドリーサービスの
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KRYSTAL 単結晶 PZT の特性について
KRYSTAL 株式会社 木島 健氏
MEMS 及び電子部品製造向けウエハプロセス装置
ズース・マイクロテック株式会社 石田 博之氏
MEMS の Total Partner - コンセプトから量産まで
住友精密工業株式会社 荒木 隆太氏
MEMS のための分析技術紹介
セイコーアイ・テクノリサーチ株式会社 西岡 誠司氏
MEMS 向けステルスレーザ加工技術の進化
株式会社ディスコ 重松 孝一氏
IoT 時代 MEMS 実装を具現化する低温・低荷重フリップチップ接合
コネクテックジャパン株式会社 小松 裕司氏

16:05-16:35 休憩時間／併設展示会コアタイム

●最新 MEMS 材料とその応用 (セッションチェア: 浜松ホトニクス株式会社 瀧本 貞治氏)

- 16:35-17:15 キーノートアドレス
Micro Sensors for the Next Big Things - IoT
Prof. Weileun Fang
Professor, National Tsing Hua University
- 17:15-17:40 Latest Trends in MEMS Wafer Technology
Mr. Martti Palokangas
Senior Manager, Customer Support
Okmetic Oy
- 17:40-18:05 圧電薄膜 (PZT) 技術を基盤とした SSSL ジャイロ製品紹介
三崎 登紀子氏
株式会社シリコンセンシングプロダクツ 生産部 ファンドリグループ マネジャー
- 18:05-18:30 多様化する MEMS デバイスの技術開発
長畑 隆也氏
ローム株式会社 オプト・モジュール生産本部 統括部長
- 18:40-20:30 **MEF 2019 交流会**
第一ホテル両国 5F

2019 年 4 月 25 日 (木)

- 8:40- 8:50 開会のご挨拶/**Award Recognition**
田中 秀治 氏
MEF 組織委員長/東北大学 大学院工学研究科 ロボティクス専攻 教授
- 注目の MEMS スタートアップ 1 (セッションチェア: Goertek Technology Japan 宮島 博志氏)
- 8:50- 9:30 キーノートアドレス
What Makes a Successful MEMS Start-up?
Dr. Kurt Petersen
Silicon Valley Band of Angels
- 9:30- 9:55 MEMS mirror enables a smart life
Mr. Yoshio Hayashi
Japan senior adviser / CEO office, UltiMEMS
- 9:55-10:20 A Miniature Low-Cost MEMS LiDAR System and its Societal Impact
Dr. Jan Kuypers
Head of MEMS, Blickfeld GmbH
- 10:20-10:50 休憩時間/併設展示
- 拡大する MEMS ビジネス (セッションチェア: アルプスアルパイン株式会社 早川 康男氏)
- 10:50-11:30 キーノートアドレス
TDK のセンサ事業展開のご紹介
飯田 淳氏
TDK 株式会社
センサシステムズビジネスカンパニー マーケティング部 部長

11:30-11:55 演題未定
Mr. Jean-Christophe Eloy
CEO & President
Yole Developpment

●出展者プレゼンテーション Part III (出展者5分ずつ、下記順に行われます)

11:55-12:55 (セッションチェア：首都大学東京 蛸島 武尚氏)

超精密鏡面加工のご案内

株式会社ティ・デイ・シー ウイレムセン 有査氏

コネクテッドインダストリ時代のセンサ・アナログ・IoT システムの開発支援：

DogNose センサ技研のご紹介

DogNose センサ技研 三原 孝士氏

ハイデルベルグ・インストルメンツ 描画装置のご紹介

ハイデルベルグ・インストルメンツ株式会社 齋藤 光徳氏

Development plan for diffusion Ion Beam Etching - Introduction of Ion Beam Etching / Milling machine

株式会社日立ハイテクノロジーズ 杉山 智氏

Sputtering Target Technology

フルヤ金属株式会社 吉田 幸介氏

独自情報網を活用して産学連携を加速させる、研究者探索プラットフォーム

株式会社 POL 加茂 倫明氏

MEMS 向け真空成膜装置のご紹介

株式会社マツボー 木下 慧氏

Business in MEMS CORE

株式会社メムス・コア 慶光院 利映氏

12:55-13:40 昼食/併設展示会コアタイム

●特別レクチャー (セッションチェア：京都大学 土屋 智由氏)

13:40-14:10 招待講演

バイオロギングシステムによる海洋生物のモニタリング

宮下 和士氏

北海道大学、北方生物圏フィールド科学センター 教授

14:10-14:50 キーノートアドレス

Bosch Deep Silicon Etching shaping MEMS

Dr. Franz Laermer

Senior Vice President, Applied Research 1 - Advanced Functional Materials and Microsystem Technologies (CR/AR1 CE-MST) , Bosch

14:50-15:15 The SMART Society envisioned by ST

Dr. Davide Bruno

Director of Marketing and Application, STMicroelectronics

15:15-16:00 休憩時間/併設展示

●注目の MEMS スタートアップ 2 (セッションチェア: SPP テクノロジーズ株式会社 田中 雅彦氏)

- 16:00-16:25 Event-driven MEMS sensors for smart safety monitoring
Dr. Alissa M. Fitzgerald
CEO, A.M. Fitzgerald & Associates, LLC
- 16:25-16:50 MEMS Ultrasonic Time-of-Flight Technology
Dr. David Horsley
CTO and Co-Founder, Chirp Microsystems
- 16:50-17:15 MEMS Loudspeakers: Challenges, Technology and Applications
Dr. Andrea Rusconi-Clerici
CTO, USound GmbH
- 17:15-17:30 R&D, commercialization and making business of the leading multi-axis tactile sensor under collaboration of industry, academia, government, investor and expert
神永 晋氏
SK グローバルアドバイザーズ株式会社 代表取締役

★グランドフィナーレパネルディスカッション
アントレプレナーシップ 好奇心と熱意でチャンスをつかめ

- 17:30-18:10
- Moderator:
神永 晋氏 SPP テクノロジーズ株式会社
- Panelists:
Dr. Kurt Petersen Silicon Valley Band of Angels
Dr. Franz Laermer Bosch
- 18:10-18:15 閉会の辞

MEF 2019 Program Schedule

Wednesday, April 24, 2019

●Opening Remarks

8:45- 8:50 Shuji Tanaka
MEF Organizing Committee Chairman
Professor, Tohoku University

●Program Overview

8:50- 9:00 Highlights of MEF 2019
Mari Nozoe
MEF Organizing Committee Vice Chairman
Hitachi High-Technologies Corporation

●Cross point between Biotechnology and MEMS

(Session chair: Ryo Miyake, MEF Organizing Committee Vice Chairman, The University of Tokyo)

9:00- 9:40 Keynote Address
History and Future of Bio MEMS
Dr. Prof. Hidetoshi Kotera
Executive Director, RIKEN

9:40-10:05 Microvessel Chip for Evaluation of Endothelial Function
Dr. Yukiko Matsunaga
Associate Professor, Institute of Industrial Science,
Department of Bioengineering, School of Engineering, The University of Tokyo

10:05-10:30 Interfaces that can reduce noise induced from biomolecules adsorption for biosensors and bioelectronics
Dr. Madoka Takai
Professor, Department of Bioengineering. The University of Tokyo

10:30-11:25 **Break/Exhibition Hour**

●Mainstream of MEMS (Session chair: Taeko Ando, Ritsumeikan University)

11:25-11:50 Generic MEMS and NEMS Platforms for a wide variety of sensors
Dr. Jean-Philippe Polizzi
Micro and Nano-systems Program Manager, CEA Leti

11:50-12:15 MEMS Sensors for Automotive Safety and for Automated Driving
Dr. Georg Bischofink
Vice President, Automotive Sensor Development
Robert Bosch GmbH

12:15-12:55 **Exhibitors' Presentation Time - Part I** (5-min each)
(Session Chair: Koichi Ohtaka, Tohoku University)

Coventor, A Lam Research Company
Yoshiyuki Kinoshita, Coventor, A Lam Research Company
Application of Xperi Direct Bonding in MEMS
Abul Nuruzzaman, Xperi/Invensas
Introduction of MEMS design tool IntelliSuite ver9.0 and Total MEMS Solution™
Ryuichi Hirade, ADVANCED TECHNOLOGIES CO., LTD.
ULVAC MEMS technology enabling 5G and the smart society
Satoshi Kawai, ULVAC, Inc.
Lighting Edge Technology for MEMS
Tomomi Kurita, USHIO INC
SPT's Process Equipment toward Trillion Sensors Universe
Hiroto Kanao, SPP Technologies Co., Ltd.

12:55-13:35 **Lunch Break/Exhibition Hour**

●**Frequency Control Devices** (Session Chair: Nobuaki Kawahara, DENSO)

13:35-14:15 Keynote Address
BAW Technology: Finding the \$in RF-MEM\$
Mr. Robert Aigner
Senior Director of Acoustic Devices R&D, Qorvo Inc.

14:15-14:40 A world's smallest 32.768 kHz MEMS resonator
Mr. Yuichi Goto
Manager, Timing Device Product Development Dept.
Murata Manufacturing Co., Ltd.

14:40-15:05 Advances in doped AlN deposition techniques for next generation Piezo-MEMS
Dr. Anthony Barker
PVD Product Manager, SPTS TechInologies Ltd.

15:05-16:05 **Exhibitors' Presentation Time - Part II**(5-min each)
(Session Chair: Koichi Ohtaka, Tohoku University)

Flexible Tactile Film using Soft Materials
Masanori Mizushima, Oga Inc.
Kyodo International & Silex Microsystems MEMS foundry service introduction
Kenji Kato, Kyoto International
Single Crystal PZT Characteristics of KRYSTAL Inc.
Takeshi Kijima, KRYSTAL Inc.
Wafer Processing Equipment for MEMS and Electronic Components Manufacturing
Hiroyuki Ishida, SUSS MicroTec KK
MEMS Total Partner - From Concept to Mass Production
Ryuta Araki, SUMITOMO PRECISION PRODUCTS Co., Ltd.
Introduction of analytical technology for MEMS
Seiji Nishioka, Seiko I Techno Research Co., Ltd.

STEALTH Dicing Technology for MEMS
Koichi Shigematsu, DISCO
Low Temperature / Low Load Flip Chip Bonding Technology Realizing MEMS
Assembly in the IoT Era
Hiroshi Komatsu, CONNECTEC JAPAN Corporation

16:05-16:35 **Break/Exhibition Hour**

●**The Breakthrough MEMS Materials** (Session Chair: Sadaharu Takimoto, Hamamatsu Photonics)

16:35-17:15 Keynote Address
Micro Sensors for the Next Big Things - IoT
Prof. Weileun Fang
Professor, National Tsing Hua University

17:15-17:40 Latest Trends in MEMS Wafer Technology
Mr. Martti Palokangas
Senior Manager, Customer Support, Okmetic Oy

17:40-18:05 SSSL Gyroscopes product based on piezoelectric thin film (PZT) technology
Ms. Tokiko Misaki
Manager, Foundry Group, Silicon Sensing Products Ltd.

18:05-18:30 Development of a diversifying MEMS device
Mr. Takaya Nagahata
Group General manager, Optical Module Production Headquarters
ROHM Co., Ltd.

18:40-20:30 **MEF 2019 Reception at Daiichi Hotel Ryogoku**

Thursday, April 25, 2019

●**Opening Remarks/Award Recognition event**

8:40- 8:50 Shuji Tanaka
MEF Organizing Committee Chairman
Professor, Tohoku University

●**Featured MEMS Start-up 1** (Session Chair: Hiroshi Miyajima, Goertek Technology Japan)

8:50- 9:30 Keynote Address
What Makes a Successful MEMS Start-up?
Dr. Kurt Petersen
Silicon Valley Band of Angels

9:30- 9:55 MEMS mirror enables a smart life
Mr. Yoshio Hayashi
Japan senior adviser / CEO office, UltiMEMS

9:55-10:20 A Miniature Low-Cost MEMS LiDAR System and its Societal Impact
Dr. Jan Kuypers
Head of MEMS, Blickfeld GmbH

10:20-10:50 **Break/Exhibition Hour**

●**Expanding MEMS Business** (Session Chair: Yasuo Hayakawa, ALPSALPINE CO., LTD.)

10:50-11:30 Keynote Address
Introduction of TDK's sensor business activities
Mr. Jun Iida
Head of Marketing Dept., Sensor Systems Business Company
TDK Corporation

11:30-11:55 Title TBA
Mr. Jean-Christophe Eloy
CEO & President, Yole Developpment

11:55-12:55 **Exhibitors' Presentation Time - Part III**
(Session Chair: Takehisa Takoshima, Tokyo Metropolitan University)

TDC's Precise Polishing Technology
Alisa Willemsen, Fine Polish TDC
Introduction of DogNose-Sensor Lab. for the Connected Industry era employing
sensor/analog/IoT technologies
Takashi Mihara, DogNoseSensorLab.
Introduction of Heidelberg Instruments Patterning products
Mitsunori Saito, Heidelberg Instruments KK
Development plan for diffusion Ion Beam Etching - Introduction of Ion Beam
Etching / Milling machine
Satoshi Sugiyama, Hitachi High-Technologies Corporation
Sputtering Target Technology
Kosuke Yoshida, FURUYA METAL CO., LTD.
Researcher searching platform to accelerate industry-academia collaboration by
utilizing proprietary information networks
Michiaki Kamo, POL Inc.
Vacuum Deposition Technologies for MEMS
Kei Kinoshita, MATSUBO Corporation
Business in MEMS CORE
Yoshiteru Keikoin, MEMS CORE Co., Ltd.

12:55-13:40 **Lunch Break/Exhibition Hour**

● **Special Session** (Session Chair: Toshiyuki Tsuchiya, Kyoto University)

- 13:40-14:10 Invited Talk
Monitoring of marine organisms using bio-logging systems
Prof. Kazushi Miyashita
Professor, Field Science Center for Northern Biosphere, Hokkaido University
- 14:10-14:50 Keynote Address
Bosch Deep Silicon Etching shaping MEMS
Dr. Franz Laermer
Senior Vice President, Applied Research 1 - Advanced Functional Materials and
Microsystem Technologies (CR/AR1 CE-MST), Bosch
- 14:50-15:15 The SMART Society envisioned by ST
Dr. Davide Bruno
Director of Marketing and Application, STMicroelectronics
- 15:15-16:00 Break/Exhibition Hour

● **Featured MEMS Start-up 2** (Session Chair: Masahiko Tanaka, SPP Technologies)

- 16:00-16:25 Event-driven MEMS sensors for smart safety monitoring
Dr. Alissa M. Fitzgerald
CEO, A.M. Fitzgerald & Associates, LLC
- 16:25-16:50 MEMS Ultrasonic Time-of-Flight Technology
Dr. David Horsley
CTO and Co-Founder, Chirp Microsystems
- 16:50-17:15 MEMS Loudspeakers: Challenges, Technology and Applications
Dr. Andrea Rusconi-Clerici
CTO, USound GmbH
- 17:15-17:30 R&D, commercialization and making business of the leading multi-axis tactile
sensor under collaboration of industry, academia, government, investor and
expert
Mr. Susumu Kaminaga
Representative Director & Chief Executive, SK Global Advisers Co., Ltd.

17:30-18:10 Grand Finale Outlook

entrepreneurship : Take a chance with curiosity and enthusiasm

Moderator

Mr. Susumu Kaminaga, SK Global Advisers Co., Ltd.

Panelists

Dr. Kurt Petersen, Silicon Valley Band of Angels

Dr. Franz Laermer, Bosch

- 18:10 Closing Remarks

MEF 2019 EXHIBITORS by Booth Number

一般企業展示

R-01	株式会社 KOKUSAI ELECTRIC
R-02	株式会社メムス・コア
R-03	新日本無線株式会社
R-04	協同インターナショナル/Silex Microsystems
R-05	ウシオ電機株式会社/PICOSUN JAPAN 株式会社
R-06	SK グローバルアドバイザーズ株式会社
R-07	ULVAC
R-08	SPP テクノロジーズ株式会社
R-09	ズース・マイクロテック株式会社 / 兼松 PWS 株式会社
R-10	ローム株式会社
R-11	Coventor, A Lam Research Company
R-12	ハイデルベルグ・インストルメンツ (株)
R-13	株式会社日立ハイテクノロジーズ
R-14	株式会社ティ・デイ・シー
R-15	株式会社村田製作所
R-16	株式会社ディスコ
R-17	株式会社 アドバンスドテクノロジー
R-18	住友精密工業株式会社
R-19	Xperi/Invensas
R-20	日本信号株式会社
R-21	株式会社デンソー
R-22	セイコーアイ・テクノロジー株式会社
R-23	株式会社マツボー
R-24	株式会社シリコンセンシングシステムズジャパン
R-25	ハイソル株式会社
R-26	フコク物産株式会社

R-28	フルヤ金属株式会社
R-29	興研株式会社
R-30	長野計器株式会社
R-31	横河電機株式会社

アカデミック展示

A-01	CEA LETI
A-02	東北大学 未来科学共同センター 桑野研究室
A-03	東北大学 田中 (秀) 研究室
A-04	東北大学 マイクロシステム融合研究開発センター
A-05	MEMS パークコンソーシアム
A-06	(一財) マイクロマシンセンター
A-07	一般社団法人 次世代センサ協議会
A-09	電気学会センサ・マイクロマシン部門
A-10	東京大学 三宅研究室
A-11	4 大学ナノ・マイクロファブリケーションコン ソーシアム

ベンチャー展示

V-01	株式会社オーギャ
V-02	KRYSTAL 株式会社
V-03	DogNose センサ技研
V-04	株式会社 POL
V-05	タッチエンス株式会社
V-06	ボールウェーブ株式会社
V-07	コネクテックジャパン株式会社
V-08	マイクロ化学技研株式会社

Regular Exhibitors

R-01	KOKUSAI ELECTRIC CORPORATION
R-02	MEMS CORE Co., Ltd.
R-03	New Japan Radio Co.,Ltd.
R-04	Kyodo International, Inc./ Silex Microsystems AB
R-05	USHIO INC./PICOSUN JAPAN
R-06	SK Global Advisers Co., Ltd.
R-07	ULVAC, Inc.
R-08	SPP Technologies Co., Ltd.
R-09	SUSS MicroTec KK/Kanematsu PWS LTD.
R-10	ROHM Co., Ltd.
R-11	Coventor, A Lam Research Company
R-12	Heidelberg Instruments KK
R-13	Hitachi High-Technologies Corporation
R-14	Fine Polish TDC
R-15	Murata Manufacturing Co., LTD.
R-16	DISCO CORPORATION
R-17	ADVANCED TECHNOLOGIES CO.,LTD.
R-18	SUMITOMO PRECISION PRODUCTS Co., Ltd.
R-19	Xperi/Invensas
R-20	NIPPON SIGNAL CO., LTD.
R-21	DENSO CORPORATION
R-22	Seiko I Techno Research Co., Ltd.
R-23	MATSUBO Corporation
R-24	Silicon Sensing Systems Japan, Ltd.
R-25	HiSOL, Inc.
R-26	Fukoku Bussan Co., Ltd.

R-28	FURUYA METAL CO., LTD.
R-29	KOKEN LTD
R-30	NAGANOKEIKI CO., LTD.
R-31	Yokogawa Electric Corporation

Academia

A-01	CEA LETI
A-02	Tohoku University - Kuwano Laboratory
A-03	Tohoku University - Tanaka Shuji Laboratory
A-04	Tohoku University - Micro System Integration Center
A-05	MEMS Park Consortium
A-06	Micromachine Center
A-07	Japan Society of Next Generation Sensor Technology
A-09	IEEJ Sensors and Micromachines
A-10	The University of Tokyo - Miyake Lab
A-11	4-University Nano/Micro Fabrication Consortium

Start-up

V-01	Oga Inc.
V-02	KRYSTAL Inc.
V-03	DogNoseSensorLab.
V-04	POL Inc.
V-05	Touchence Inc.
V-06	Ball Wave Inc.
V-07	CONNECTEC JAPAN Corporation
V-08	Institute of Microchemical Technology

MEF 2019 EXHIBITION – FLOOR Layout



MEF 2019 SPEAKERS by Alphabetical Order -A-

Presentation Time: 24-Apr 13:35-14:15

BAW Technology: Finding the \$in RF-MEM\$

Mr. Robert Aigner
Senior Director of Acoustic Devices R&D, Qorvo Inc.



Abstract:

Future wireless communication standards require RF filters with unprecedented performance and complexity. Pressure is high to squeeze in more functionality into the limited size allocated for the radio system in a smartphone. Bulk Acoustic Wave (BAW) filters have been in volume production since year 2001 and growth rates have been astonishing. The market for BAW filters exceeds 15 billion units in year. The presentation highlights the factors contributing to this success and tries to explain why few companies are positioned to win. Stringent specifications for co-existence between legacy and new bands require ongoing innovations and upgrades to existing process and products. Carrier Aggregation has brought a new set of challenges to be discussed in detail. Increasing the band-count and functionality without growing x-y-z dimensions becomes more challenging with every generation of products. The next big market for BAW is 5G wireless in the frequency range from 3.5 to 6 GHz.

Biography:

Robert Aigner received a Ph.D. degree from Munich Technical University in 1996 for research on micromachined chemical sensors. He was a visiting scientist at UC Berkeley Sensors and Actuators Center BSAC in 1996. He joined the MEMS research group at Siemens Corporate Technology in 1997. Between 1999 and 2005 he was director of a MEMS R&D department at Infineon Technologies and worked on a variety of MEMS devices including Automotive MEMS and RF-MEMS. The team he built and directed became pioneers in commercializing Bulk-Acoustic-Wave (BAW) technology. In 2006 he joined TriQuint in Apopka/Florida to establish BAW. TriQuint merged into Qorvo in early 2015. As head of R&D for acoustic filter technology at Qorvo his focus is on driving technology innovations in the fields of SAW and BAW. He has served in several European committees for Microsystem Technology and was nominated as MEMS-expert for European Commission. He participated in the technical program committee of IEEE UFFC and serves as reviewer for JMEMS, Applied Physics Letters and other journals. He has more than 110 patents (from 80 patent families) in the field of BAW, SAW and MEMS granted on his name, has published more than 110 articles and contributed chapters to four text books.

MEF 2019 SPEAKERS by Alphabetical Order -B-

Presentation Time: 24-Apr 14:40-15:05

Advances in doped AlN deposition techniques for next generation Piezo-MEMS

Dr. Anthony Barker
PVD Product Manager, SPTS Technologies Ltd



Abstract:

In BAW and Piezo-MEMS devices, AlN film stress state is of utmost importance and to maximise yield, manufacturers look to minimise stress variation across the wafer. When Sc is added to the film the problem becomes more demanding, as stress range tends to worsen with increased Sc content. Previous methods to control stress reach a limit of capability, impacting yield or compromising device design and performance. In addition to stress control, a related issue presents itself when Sc is added to an AlN film. During deposition, crystallites can form within the AlScN. Effectively defects in the film, the crystallite presence degrades resonator properties - dead volume amongst the piezoelectric bulk. Formation is abundant in areas of tensile stress, hence the relation to stress control. As with stress profile, crystallite density increases with Sc content so management of crystallite formation becomes another requirement for the PVD process, to ensure coupling coefficient yields are maximised. Here we present a novel solution providing symmetrical control and adjustment of stress for AlN films with different Sc content, demonstrating excellent WIW stress performance, the ability to locally tune stress, and approaches to prevent formation of crystallite defects, maximising yield.

Biography:

Dr Anthony Barker joined Surface Technology Systems (STS) in 1997 as Etch Process Engineer. He went on to manage STS' non-Si based etch and deposition process groups. After leaving STS he joined Trikon as Etch Process Engineer in 2005, which became Aviza Technology and then merged with STS to form SPTS Technologies in 2009. Most recently Anthony worked as Principal Process Engineer in R&D Accounts group before joining SPTS's PVD Product Management team in May 2017. Before STS, Anthony worked as Thin Film Process Engineer at Gems Sensors. Dr Barker has a B.Eng Honours degree in Materials Engineering and a Ph.D in Electronic Materials in association with Rolls Royce, both from Swansea University.

MEF 2019 SPEAKERS by Alphabetical Order -B-

Presentation Time: 24-Apr 11:50-12:15

MEMS-Sensors for Automotive Safety and Automated Driving

Dr. Georg Bischopink
Vice President, Automotive Sensor Development
Robert Bosch GmbH, Germany



Abstract:

Electrified, automated, connected - these three trends are describing the fundamental change, that the automotive industry is facing in the next decade.

MEMS technology and sensors is one of the pacemaker in this radical change.

In this presentation the new requirements in automated driving will be discussed for inertial sensors. A focus will give on innovative technologies and designs enabling the new functions and specification enhancement.

The trend towards a further increase in performance and features continues:

- Increasingly smaller sensors
- More powerful sensors with the highest possible offset stability and noise performance
- Sensors with superior vibrational robustness

Looking at the new applications from the perspective of a MEMS supplier, we will also consider chances from transferring Consumer Electronics technologies to Automotive.

Biography:

Education:

1983-1988 Master's degree in Physics, University Paderborn, Germany
1988-1992 Ph.D. in Semiconductor Physics: Crystal Growth of (AlGa)Sb,
University Freiburg, Germany

Professional Experience:

1992-today Robert-Bosch GmbH, Germany
1992-1995 Quality Assurance, Hybrid and Sensors
1995-1996 Development, MEMS-Sensors
1996-2000 Section Manager, Development MEMS Sensor Products
2000-2008 Director, Bosch MEMS-Production
2008-09/2012 Director, Bosch Corporate Research Microsystem-Technology
10/2012-today Vice President, Bosch Engineering Sensors for External Customers and lead Product Area Sensors Automotive

MEF 2019 SPEAKERS by Alphabetical Order -B-

Presentation Time: 25-Apr 14:50-15:15

The SMART Society envisioned by ST

Mr. Davide Bruno

Director of Marketing and Application, STMicroelectronics



Abstract:

How the sensors will pervade our life and our daily experiences, from intelligent cars to intelligent cities and ultimately how they will change our way to interact within our society.

Biography;

Master degree in Engineering in 2002 and started working with STMicroelectronics as field application engineer till 2009 when he moved to work in Japan as marketer and eventually head of Marketing for Analog, MEMS and Sensors

MEF 2019 SPEAKERS by Alphabetical Order -E-

Presentation Time: 25-Apr 11:30-11:55

Mr. Jean-Christophe Eloy
CEO & President
Yole Developpment



MEF 2019 SPEAKERS by Alphabetical Order -F-

Presentation Time: 24-Apr 16:35-17:15

Micro Sensors for the Next Big Things - IoT

Prof. Weileun Fang
Professor, National Tsing Hua University



Abstract:

Internet of Things (IoT) becomes a powerful engine to the fourth industrial revolution for humankind, which covers the interactive implementations of smart city, smart manufacturing, smart living, smart vehicle, and smart me (e.g., fitness, wellness, and health care). As a key driver for IoT, the Micro-Electro-Mechanical-Systems (MEMS) sensors and actuators have been widely employed in current consumer and wearable electronics. Thus the technologies to implement and integrate micro sensors, actuators, and integrated circuits (ICs) attract a lot of attentions from academia and industry. The mature CMOS fabrication processes are available in many IC foundries. It is cost-effective to exploit the existing CMOS fabrication technologies to implement micro devices for IoT applications. This talk presents the approach to implement and integrate various MEMS transducers by using the standard CMOS processes. Moreover, the MEMS ecosystems at Taiwan is also introduced. This talk will further show many possibilities to integrate and network the existing MEMS resources and organizations in Taiwan. Thus, the development of micro sensors and IoT could be enhanced by leveraging the MEMS ecosystems at Taiwan.

Biography:

Prof. Fang has been working in the MEMS field for more than 20 years. He received his Ph.D. degree from Carnegie Mellon University (Pittsburgh, PA) in 1995. He joined the National Tsing Hua University (Taiwan) in 1996, where he is now a Chair Professor. He became the IEEE Fellow in 2015 to recognize his contribution in MEMS area. Prof. Fang has published ~400 refereed papers and granted ~80 patents. He is now the Chief Editor of JMM, the Board Member of IEEE TDMR, and the Associate Editor of IEEE Sensors J., and Sensors and Actuators A. He served as the General Chair or Program Chair for many important international conferences: the World Micromachine Summit 2012, IEEE Sensors 2012, and Transducers 2017. He has become the chair of International Steering Committee of Transducers from 2017. He also served as the Technical Program committee of IEEE MEMS and Transducers for many years. So far near 50 PhD and 70 Master students have graduated from Prof. Fang's group. Most of them are working in the MEMS and micro sensors related companies. Thus, Prof. Fang has close relation with MEMS industries, and is now the VP of MEMS Committee of SEMI Taiwan.

MEF 2019 SPEAKERS by Alphabetical Order -F-

Presentation Time: 25-Apr 16:00-16:25

Event-driven MEMS sensors for smart safety monitoring

Dr. Alissa M. Fitzgerald
CEO, A.M. Fitzgerald & Associates, LLC



Abstract:

An event-driven sensor, or “zero power” sensor, is open circuit and consumes no power while it waits to detect a mechanical or thermal event. When the event occurs, an electro-mechanical switch closes, and then the sensor can draw power from its battery to transmit data. In this talk, I will describe some recent innovations in event-driven MEMS sensor design and how these sensors could be used for smart safety or security applications. Monitoring large areas, over long periods of time, will be possible without needing battery changes. These cleverly designed sensors are based on existing MEMS fabrication processes and could be commercialized within the next 5 years.

Biography:

Dr. Fitzgerald has over 25 years of engineering experience in MEMS design, fabrication and product development. She now advises clients on the entire cycle of microelectronic product development, from business and IP strategy to supply chain and manufacturing operations. Prior to founding AMFitzgerald in 2003, Dr. Fitzgerald worked in engineering positions at the Jet Propulsion Laboratory, Orbital Sciences Corporation, Sigpro, and Sensant Corporation, now part of Siemens. She received her bachelor's and master's degrees from MIT and her doctorate from Stanford University in Aeronautics and Astronautics. She served as a director on the MEMS Industry Group's (MIG) Governing Council from 2008-2014. In 2013, she was inducted into the MIG Hall of Fame. She currently serves on the Board of Directors of the Transducer Research Foundation and Rigetti Computing.

MEF 2019 SPEAKERS by Alphabetical Order -G-

Presentation Time: 24-Apr 14:15-14:40

A world's smallest 32.768 kHz MEMS resonator

Mr. Yuichi Goto
Manager, Timing Device Product Development Dept.
Murata Manufacturing Co., Ltd.



世界最小 32.768 kHz MEMS 振動子
後藤 雄一氏
株式会社村田製作所 タイミングデバイス商品開発部マネージャー

Abstract:

Murata has been manufacturing and supplying ceramic and quartz based timing devices for many years. As the next generation timing device, a MEMS-based 32 kHz resonator is designed, simulated, and manufactured. The chip scale package (CSP) dimensions are 0.9 mm x 0.6 mm which is more than a 50% reduction in comparison to the smallest quartz crystal tuning fork resonator available today. The load capacitances required for the oscillation circuit are integrated within the CSP, which offers the smallest size of any 32 kHz solution. Despite the size reduction, the MEMS resonator is electronically equivalent to the quartz crystal tuning fork resonator. To meet the stringent timing accuracy requirements without electronic compensation, the MEMS resonators are trimmed to +/-20 ppm accuracy. As no active circuit based compensation is required, the presented resonator offers power and oscillator circuit area savings in comparison to prior MEMS oscillators that require phase locked loop (PLL) compensation. The functionality of the MEMS resonator is demonstrated by using the oscillator functionality in a common microcontroller ASIC.

Biography:

Yuichi Goto is leading MEMS timing device development at Murata Manufacturing Co., Ltd. His responsibilities are new MEMS resonator development and managing of resonator production.

He has received B.E. and M.E. in electric engineering and computer science from Waseda university. After graduation, he joined Murata Manufacturing Co., Ltd. and worked as a design engineer of piezo material based devices. "

MEF 2019 SPEAKERS by Alphabetical Order -H-

Presentation Time: 25-Apr 9:30- 9:55

MEMS mirror enables a smart life

Mr. Yoshio Hayashi
Japan senior adviser / CEO office
UltiMEMS



Abstract:

MEMS technology has changed our life style in the past decades. There are more and more MEMS devices used in our daily life to make a smarter life, and the change is still going on. MEMS mirror is one of the unique MEMS devices which can be integrated into various smart systems and serve its special features in different applications.

Ultimems is a company specialized in MEMS mirror design. In this presentation, we will share our vision on the MEMS mirror opportunities in the market and introduce the solutions Ultimems can provide.

Biography:

Graduate Shibaura Institute of Technology in 1972
Work at Tokyo Institute of Technology till 1980
Optical head development in Sankyo & Sanyo till 2012
2015—Ultimems

MEF 2019 SPEAKERS by Alphabetical Order -H-

Presentation Time: 25-Apr 16:25-16:50

MEMS Ultrasonic Time-of-Flight Technology

Dr. David Horsley
CTO and Co-Founder
Chirp Microsystems



Abstract:

Ultrasonic time-of-flight (ToF) sensors are commonly recognized as the best range-sensors for automotive and industrial applications — as well as for drones and robotics. They offer numerous advantages over optical or infrared sensors. They are robust, accurate, and reliable and deliver the most accurate range measurement regardless of target size or color, are immune to ambient noise, and they work in direct sunlight. However, until today, ultrasonic sensors required complicated signal processing and were too big to fit into consumer electronics devices. Now, TDK's Chirp Microsystems is introducing a line of tiny MEMS-based ultrasonic sensors that offer the same performance and reliability as conventional ultrasonic sensors but with a form-factor up to 1000 times smaller and a power consumption up to 100 times lower than that of conventional ultrasonic sensors. The miniature sensors are small enough to enable the entire spectrum of ultrasonic sensing in compact consumer applications such as smartphones and wearables. The new MEMS ultrasonic sensors are predestined for applications such as drones and robots where other range sensors cannot produce the required performance. They are also ideal for smart home products such as smart speakers, where passive infrared (PIR) and optical proximity sensors are not as effective.

Biography:

David Horsley is CTO of Chirp Microsystems Inc. (a TDK Group Company), a manufacturer of ultrasonic sensors using MEMS technology. Dr. Horsley is also a Professor of Mechanical and Aerospace Engineering at the University of California, Davis, and Adjunct Professor of Mechanical Engineering at the University of California, Berkeley. Since 2004, he has been Co-Director of the Berkeley Sensor and Actuator Center (BSAC), the US National Science Foundation's Industrial/University Collaborative Research Center (I/UCRC) focused on MEMS research. Dr. Horsley was Co-Chair of the 2016 IEEE Sensors Conference, Co-Chair of the 2017 Transducers Research Foundation Napa Microsystems Workshop, and he is the Co-Chair of the 2020 IEEE MEMS Conference. Dr. Horsley is a recipient of the National Science Foundation's CAREER Award, the Outstanding Junior Faculty Award at UC Davis, the 2016 NSF I/UCRC Association's Schwarzkopf Award for Technological Innovation, the 2018 East Bay Innovation Award, and has authored or co-authored over 150 scientific papers and holds over 20 patents.

MEF 2019 SPEAKERS by Alphabetical Order -I-

Presentation Time: 25-Apr 10:50-11:30

Introduction of TDK's sensor business activities

Jun Iida
Head of Marketing Dept., Sensor Systems Business Company
TDK Corporation

TDK のセンサ事業展開のご紹介
飯田 淳氏 TDK 株式会社
センサシステムズビジネスカンパニー マーケティング部部長



MEF 2019 SPEAKERS by Alphabetical Order -K-

Presentation Time: 25-Apr 17:15-17:30

R&D, commercialization and making business of the leading multi-axis tactile sensor under collaboration of industry, academia, government, investor and expert.

Mr. Susumu Kaminaga
Representative Director & Chief Executive, SK Global Advisers Co., Ltd.



最先端触覚センサの研究開発から製品化・事業化
～産学官、事業開発投資家、有識専門家の協業～
神永 晋氏 SK グローバルアドバイザーズ株式会社 代表取締役

Abstract:

Development of new technology & business being tried through collaboration of an SME, a venture business, university, government, a business-developing investor, an expert and larger companies is presented. The SME initiated new business development picked up the state-of-the-art technology from university. A venture business was established as its subsidiary to materialize the technology and financially supported by a government organization, forming industry-academia-government collaboration. A lot of interests coming from industry require the business to commercialize the technology with more sophisticated development and it is supported by a business-developing investor and an MEMS expert. Collaborative work with larger companies to develop various application is ongoing. The technology is the world smallest multi-axis tactile sensor invented by the Professor Shimoyama's Laboratory at the University of Tokyo and the venture business is called Touchence. The speaker joins the business as the expert in MEMS society as a result of his career with MEMS over 30 years, starting with commercialization of DRIE and other micromachining technologies, followed by business development of MEMS devices and wireless sensor network. As IoT is coming up, his continuing work reached involvement in the Trillion Sensors Initiative which aims to encourage people all over the world to create new ideas about new sensors to be commercialized for real business to contribute to the society on the Earth. Touchence business will open up the future society where people can enjoy healthy and comfortable life.

Biography:

Susumu Kaminaga studied Mechanical Engineering at the University of Tokyo and graduated in 1969. He joined Sumitomo Precision Products Co., Ltd. (SPP) and was President of the company from 2004 to 2012. He is currently Executive Senior Adviser at SPP Technologies Co., Ltd. as well as Representative Director & Chief Executive at SK Global Advisers Co., Ltd. He lived in Germany in the 1980s and U.K. in 1990s. Having been involved with MEMS activities since 1988, he played a major role to develop and commercialize Deep Reactive Ion Etching (DRIE) technology based on Robert Bosch patented switching process at Surface Technology Systems (STS), UK subsidiary of SPP and introduced the world first DRIE equipment into the market in 1995. The DRIE has enabled MEMS world to expand rapidly in the last decades since then. Following his achievement to establish MEMS business with the processing technologies, gyroscopes and wireless sensor network systems, he became a member of the organizing committee of Trillion Sensors (TSensors) Summit to drive TSensors Initiative. He is Fellow of JSME (The Japan Society of Mechanical Engineers) and a member of JSAP (The Japan Society of Applied Physics), IEE (The Institute of Electrical Engineers of Japan) and IEEE (The Institute of Electrical and Electronic Engineers).

MEF 2019 SPEAKERS by Alphabetical Order -K-

Presentation Time: 24-Apr 9:00-9:40

History and Future of Bio MEMS

Dr. Prof. Hidetoshi Kotera
Executive Director, RIKEN



バイオ MEMS の歴史と将来
小寺 秀俊氏 国立研究開発法人理化学研究所 理事

Abstract:

In the field of Bio technology, regenerative medicine and medical, Micro Electro-Mechanical Systems(MEMS)and Micro Total Analysis Systems (Micro-TAS) are indispensable devices not only for research but clinical treatment. We had been developing the material, manufacturing process and fabrication technologies. In my presentation, I will refer the history of research of Bio MEMS and Micro TAS, and discuss about the future.

Biography:

Hidetoshi Kotera is a Executive Director, RIKEN, Japan.

He received his doctorate in engineering from Kyoto University in 1993.

He became a research scientist and manager at the Central Research Laboratory of Matsushita Electric Industrial Co., Ltd (1982-1993), and was employed as an associate professor at Kyoto University's Department of Mechanical Engineering, School of Engineering (1993-1996), then at the Post Graduate school of engineering, Department of Mechanical Engineering (1996-2000). In 2000, he attained a full professorship in the same department before assuming his position as a professor in the Department of Micro-Engineering (2003-2018). He was appointed as vice-president (2009-2012), and executive vice president (2012-2014). He is now appointed as a Bureau of the OECD/CTSP.

MEF 2019 SPEAKERS by Alphabetical Order -K-

Presentation Time: 25-Apr 9:55-10:20

A Miniature Low-Cost MEMS LiDAR System and its Societal Impact

Dr. Jan Kuypers
Head of MEMS, Blickfeld GmbH



Abstract:

The availability of a compact and low-cost LiDAR system and its widespread deployment are expected to have a significant beneficial impact on our society. The availability of a high-performance mass market LiDAR system is not only critical to enable self-driving cars, but will find application including public safety, transportation, parking, manufacturing, home-automation, online apparel-ordering, interior design, professional and recreational sports, amongst many others.

The presentation will review the required performance and cost targets to penetrate the different markets. For most applications the cost and size of the entire LiDAR unit should be comparable to a compact digital camera. Furthermore, it should achieve a field of view of 100°, frame rate of 20 Hz, and accuracy in the centimeter range, and for some applications operate beyond a distance of 100 m. Proven technical solutions to date do not achieve the combination of high-performance, low-cost and compact size. The presentation will review different LiDAR architectures and illustrate how a novel MEMS scanner can provide an attractive solution. We will also highlight the challenges that such a mechanical system faces in regards to stable and reliable operation.

Biography:

Jan H. Kuypers (M'05) received the Dipl.- Ing. degree from the Department of Microsystem Technology IMTEK at the University of Freiburg, Germany, in 2004, and the Ph.D. degree in Nanomechanics from Tohoku University, Sendai, Japan, in 2007. After working as research specialist at the Berkeley Sensor and Actuator Center (BSAC) at the University of California at Berkeley, he joined Sand 9, a Boston based start-up company developing innovative MEMS timing solutions in 2008. In 2014, after advancing to Director of MEMS Engineering, and then Chief Science Officer, he continued his support of Sand 9 as advisor while joining TriQuint Semiconductor (now Qorvo). Dr. Kuypers was responsible for managing two teams, one in the US and one in Germany, as part of the Surface Acoustic Wave R&D group. As of 2018 he is managing the MEMS development at Blickfeld GmbH, based in Munich, Germany. The aim is to bring a compact low-cost MEMS LiDAR system to market. He has been a Member of the technical program committee at the IEEE Ultrasonics Symposium since 2007 and Frequency Control Symposium since 2012. Dr. Kuypers' great passion is developing innovative MEMS products.

MEF 2019 SPEAKERS by Alphabetical Order -L-

Presentation Time: 25-Apr 14:10-14:50

Bosch Deep Silicon Etching shaping MEMS

Dr. Franz Laermer

**Senior Vice President, Applied Research 1 - Advanced Functional Materials and
Microsystem Technologies (CR/AR1 CE-MST), Bosch**



Abstract:

Bosch DRIE has enabled the huge variety of micromachined silicon structures which are at the core of all of today's MEMS sensors. Invented at Bosch Corporate Research in 1992, the technology was industrialized in partnership with Surface Technology Systems Ltd., a UK-based equipment supplier and subsidiary of Sumitomo Precision Products Ltd., JP. The history of the invention, its successful development, industrialization and market penetration as the leading MEMS microstructuring technology of today, as well as the most important sensors and sensor application areas will be discussed in the talk, spanning the range from automotive to consumer into the internet-of-things.

Biography:

Franz Laermer joined Bosch Corporate Research in 1990 where he started the development of new microstructuring technologies and sensor functionalities in the upcoming field of MEMS. In 1992, he invented the BOSCH DRIE process for silicon micromachining, together with his co-worker Andrea Urban. Since 2005, he is in charge of innovation projects expanding the scope of MEMS into new areas beyond automotive and consumer, encompassing medical applications, eg. a microfluidic Lab-on-Chip platform for molecular diagnostics ("Vivalytic"). He received the 2007 European Inventor Award and the 2014 IEEE Jun-ichi Nishizawa Medal Award for the invention and sustainable success of the BOSCH DRIE process. In 2018 he was appointed as BOSCH Research Fellow.

MEF 2019 SPEAKERS by Alphabetical Order -M-

Presentation Time: 24-Apr 9:40-10:05

Microvessel Chip for Evaluation of Endothelial Function

Prof. Yukiko T. Matsunaga
Associate Professor, Institute of Industrial Science, Department of
Bioengineering,
School of Engineering
The University of Tokyo



血管機能評価のための微小血管チップ

松永 行子氏

東京大学生産技術研究所 大学院工学系研究科バイオエンジニアリング専攻 准教授

Abstract:

Inhibiting or normalizing pathological angiogenesis is a therapeutic strategy that has been extensively studied and already brought up clinically with approved drugs. However, most experimental assays for drug development rely on 2D cell culture models, which fail to mimic sprouting from a parent vessel. We have developed a microvessel-on-a-chip which enables the study of drugs targeting a specific pathway of angiogenesis. Microvessels were prepared using human umbilical vein endothelial cells (HUVEC) within a collagen gel scaffold. It was revealed that the technology enables to contribute to improve the discovery of promising anti-angiogenic molecules and provide a convenient tool to assess fundamental questions about mechanisms at an endothelial cellular level during angiogenesis.

Biography

Dr. Yukiko T. Matsunaga obtained a Ph.D. degree about the research on cell sheet engineering at Tsukuba University in 2007. She is currently an Associate Professor at the Institute of Industrial Science, The University of Tokyo. Her laboratory works at the interface between biology and engineering and uses innovative approaches to create micro-scaled three-dimensional bio-structures that mimic the architecture and complexity of living tissues. These micro-tissues find applications in basic, translational, and applied research. Dr. Matsunaga's laboratory puts an emphasis on creating healthy and diseased blood vessels, notably for the study of aging and cancer. Dr. Matsunaga is also eager to use her research for raising awareness of how environment and life style can affect our blood vessels and ultimately improve life through vascular health. She has received the MEXT Minister Prize for Young Scientist in 2018.

MEF 2019 SPEAKERS by Alphabetical Order -M-

Presentation Time: 24-Apr 17:40-18:05

SSSL Gyroscopes product based on piezoelectric thin film (PZT) technology

Ms. Tokiko Misaki

Manager, Foundry Group Silicon Sensing Products Ltd.

圧電薄膜（PZT）技術を基盤とした SSSL ジャイロ製品紹介
三崎 登紀子氏 株式会社シリコンセンシングプロダクツ
生産部 ファンドリグループ マネジャー



Abstract:

Since its establishment in 1999, Silicon Sensing Products (SSP) has been mass-producing MEMS gyroscopes and has had over 30 million cumulative shipments. The class-leading small size MEMS gyros using piezoelectric thin film (PZT material) have already shipped more than about 3 million. SSP began the "MEMS Foundry Service" business in 2009, which applied MEMS process know-how and experience of gyroscopic mass production. We provide customized MEMS process that is optimized for customer's designed products such as ink jet heads, mirror devices, infrared sensors, ultrasonic sensors and so on. SSP is developing 8 inch wafer size PZT film and improving the reliability. In this presentation, I will introduce our PZT gyroscopes "Pinpoint" and the characteristics of our PZT film.

Biography:

Tokiko Misaki joined Sumitomo Precision Products in 2000.

She worked as a MEMS process engineer in the department of development of MEMS devise. She had been engaged in process development of MEMS devises such as micro pump, MEMS mirror, MEMS probe, and MEMS devices for optical communication from 2003 to 2018.

In 2018, Misaki was transferred to Silicon Sensing Products which is a 50/50 Joint Venture owned by Sumitomo Precision Products (Japan) and Collins Aerospace Systems (USA). She is currently in charge of global MEMS foundry business.

MEF 2019 SPEAKERS by Alphabetical Order -M-

Presentation Time: 25-Apr 13:40-14:10

Monitoring of marine organisms using bio-logging systems

Prof. Kazushi Miyashita
Professor, Field Science Center for Northern Biosphere, Hokkaido University



バイオロギングシステムによる海洋生物のモニタリング
宮下 和士氏
北海道大学 北方生物圏フィールド科学センター 教授

Abstract:

In this presentation, I explain the bio-logging method for monitoring of marine organisms, and introduced the related our advanced project “Construction of advanced bio-logging system to implement high data recovery rate -a challenging study to clarify the dynamics of the fish population and community.

Biography:

Dr. Miyashita is a professor at Hokkaido University, Japan. He received his Ph.D. in aquatic biology from the University of Tokyo in 1996. His research is focused on the development and application of quantitative sensing methods for understanding marine organisms and ecosystems. Recently, he also started to study about sustainable developments of marine ecosystem using his developed new monitoring methods.

MEF 2019 SPEAKERS by Alphabetical Order -N-

Presentation Time: 24-Apr 18:05-18:30

Development of a diversifying MEMS device

Mr. Takaya Nagahata
Group General manager, Optical Module Production Headquarters,
ROHM Co., Ltd.



多様化する MEMS デバイスの技術開発
長畑 隆也氏 ローム株式会社 オプト・モジュール生産本部 統括部長

Abstract:

Sensing technology attracts a lot of attention in various industries as a technology for creating new values, and numerous solutions are being proposed. In the 5G market, there is a tendency to focus on developing services that use data analysis and AI technology. It is clear that data acquisition is the foundation to support those activities. This is because people have to collect the right data for their right purpose. ROHM has been traditionally manufacturing sensor devices, low-power consumption microcontrollers, wireless communication modules, and so on to meet the needs of right date collection. In order to accelerate the market expansion, Rohm focused on developing sensor solution with built-in algorithm optimized for applications, and modules that integrate wireless communication to client's satisfaction. Those solution has been achieved by MEMS device development
The market demand diverges into many branches and needs many unique techniques which are changing with each passing day.. What we can do is to combining all of our advantages and introduce new MEMS device to the market."

Biography:

Takaya Nagahata is Group General Manager of Optical Module Production Headquarters since June 2016. He has built up the business firstly around manufacturing innovative joint-developed MEMS actuator. Secondly, Sensors solution for IoT Business in Machine Heath and industrial market. Thirdly Automobile including Wireless and MCU. And also wearables.
He enhance the development of new MEMS device by integrate the Thin Film piezoelectric and MEMS technique, for example, accelerometer, Gyro, piezoelectric microphone, Infrared sensor, ultrasonic sensor, and industrial actuator.

Takaya Nagahata graduated from physical properties studies of Kansai University in Osaka, Japan and engaged Thermal print head and Contact image sensor in Barcode and POS printer market from 1983 to 1998.

Thereafter from 1998 to 2008, He took the leadership in micro lens array, energy harvester material in particular and has experience of start-up factory including administered brand new factory in China. Thereafter from 2008 to 2016, He took the leadership in MEMS device, accelerometer and Gyro, magnetic sensors, Actuator.

Up to now, Takaya Nagahata brought these devices up to worldwide No. 1 share and possesses more than 200 patents in thermal print head.

MEF 2019 SPEAKERS by Alphabetical Order -P-

Presentation Time: 24-Apr 17:15-17:40

Latest Trends in MEMS Wafer Technology

Mr. Martti Palokangas
Senior Manager, Customer Support Okmetic Oy



Abstract:

MEMS wafer market is growing and materials have increasing importance. This presentation introduces current trends of wafer materials in MEMS. Market trends for lower cost and higher volumes of end products are driving towards miniaturization of MEMS. Requirements for reliability and performance improvements on the other hand drive for improvements in precision of BSOI materials, and use of hermetically sealed structures enabled by Cavity SOI (C-SOI) wafers or wafer level packaging. Following examples of advanced substrate-based solutions are discussed:

- Comparison of different SOI substrates from process integration and manufacturing complexity point of view. Benefits of SOI and C-SOI based approach for flatness and dimensional precision of the released structures.
- C-SOI based approach for high performance inertial sensors: process integration, reliability and performance optimization.

Okmetic's new turnkey solution of providing full in-house C-SOI process flow, from silicon crystal growth to cavity patterning and SOI wafer manufacturing, from one source is introduced.

Biography:

Mr. Palokangas received M.Sc. degree in Electrical and Communications Engineering in 2002 from Helsinki University of Technology (Finland). He has over 15 years of experience in silicon based material engineering. He joined the R&D group of Okmetic right after his graduation, and has since then worked as a Specialist on development of SOI based wafers, Senior Product Development Engineer, SOI Production Manager and Manufacturing Engineering Manager. In the last mentioned role he was responsible for setting up patterning production line at Okmetic Vantaa facility as the project manager. Currently he is working as Senior Manager, Customer Support being responsible for the company's global technical customer support organization.

MEF 2019 SPEAKERS by Alphabetical Order -P-

Presentation Time: 25-Apr 8:50-9:30

What Makes a Successful MEMS Start-up?

Dr. Kurt Petersen

Co-Chair of HardTech Group, Silicon Valley Band of Angels



Abstract:

Many factors influence whether a start-up company is considered successful or not. Indeed, even how one defines “successful” can be open to interpretation. Drawing from our experience with over 30 relatively recent MEMS-based start-ups, this talk will explore technical success or failure, financial success or failure, and strategic success or failure. We will discuss clearly successful MEMS companies, such as InvenSense, CardioMEMS, Cambridge CMOS, and SiTime as well as clearly unsuccessful companies, such as Akustica, Discera, and Sand 9. We will also discuss “intermediate” stories, such as WiSpry, Silicon Clocks, and Iridigm. We will consider their technology, their team, their market, their competition, and their execution. We will try to extract some lessons and some advice for future MEMS-based start-up companies.

Biography:

Kurt Petersen received his BS degree cum laude in EE from UC Berkeley in 1970, and a PhD in EE from the Massachusetts Institute of Technology in 1975. Since 1982, he has co-founded six successful, high-tech companies in Silicon Valley, including Cepheid (was on NASDAQ: CPHD; acquired by Danaher in 2016 for \$4B) and SiTime (acquired by MegaChips in 2014). In 2001, he was awarded the IEEE Simon Ramo Medal for his contributions to MEMS. In 2019, he was awarded the prestigious IEEE Medal of Honor. Dr. Petersen is a member of the National Academy of Engineering and is a Life Fellow of the IEEE in recognition of his contributions to “the commercialization of MEMS technology”. In 2011, Dr. Petersen joined the Silicon Valley Band of Angels. Today, he spends his time helping and mentoring early stage, high-tech start-up companies.

MEF 2019 SPEAKERS by Alphabetical Order -P-

Presentation Time: 24-Apr 11:25-11:50

Generic MEMS and NEMS Platforms for a wide variety of sensors

Dr. Jean-Philippe Polizzi
Micro and Nano-systems Program Manager, CEA Leti



Abstract:

With the huge deployment of sensors in consumer products, the MEMS industry has experienced exponential growth in the last decade, but is now facing commoditization of its products. That means market saturation and shrinking margins.

Unfortunately, technology development is expensive. In this context, it becomes more and more important to standardize processes and increase their re-use. Although a single process capable of addressing the whole variety of MEMS remains unachievable, Leti has developed generic platforms that allow maximum re-use of previous developments and faster time to prototype. These platforms, and their evolution in the last decade will be presented here.

Biography:

Jean-Philippe Polizzi has been involved for more than 25 years in the field of microsystem based products developments in different companies and research institutes. At SAGEM, he participated to micromachined pressure sensors and accelerometers development for the automotive market. He joined Auxitrol in 1997 as the pressure sensor group manager, where he developed a variety of MEMS based aerospace sensors for clients such as Airbus or Boeing. From 2002 to 2004, he was the head of the MEMS group in Thales corporate research center, where he worked on RF switches and piezo-electric sensors and actuators. He is currently in charge of strategy and business development for the MEMS sensors and actuator activity at CEA Leti.

MEF 2019 SPEAKERS by Alphabetical Order -R-

Presentation Time: 25-Apr 16:50-17:15

MEMS Loudspeakers: Challenges, Technology and Applications

Dr. Andrea Rusconi-Clerici
CTO, USound GmbH



Abstract:

USound is challenging the status quo of the micro-acoustic market with a silicon MEMS Loudspeaker technology which has great potential, triggering comparable disrupting dynamics as for MEMS microphones and LEDs. MEMS Loudspeakers are well suited in the field of micro-acoustics, in particular, wired and wireless earphones, AR glasses, wearables, VR/Gaming headphones and portable consumer devices. Compared to micro speakers based on voice coil, piezo MEMS are superior in three categories: sound quality, form factor, system integration.

The biggest challenge in generating high sound pressure levels in a tiny form factor is to be able to generate large forces and elongations in a linear way. This has always been the obstacle for MEMS "

Biography:

Andrea Rusconi Clerici has 20 years technical experience in the MEMS industry being involved Technology in R&D, product development, manufacturing engineering and operations. He has experience in research (Fraunhofer Institute), large companies (STMicroelectronics, Maxim Integrated) and start-up (Sensordynamics). At STMicroelectronics he was a key player for realizing the impressive MEMS business growth from scratch to 250M\$/Y in 5 years; achievements ranged from new technologies IP and development to product families mass production. He co-founded USound with the mission of bringing MEMS based micro speakers to the market".

He serves now as a co-founder and CTO of USound with the goal of developing ground breaking technologies for MEMS Loudspeakers.

MEF 2019 SPEAKERS by Alphabetical Order -T-

Presentation Time: 24-Apr 10:05-10:30

Interfaces that can reduce noise induced from biomolecules adsorption for biosensors and bioelectronics

Dr. Madoka Takai

Professor, Department of Bioengineering, The University of Tokyo

バイオセンサー、バイオデバイスにおける生体分子の吸着が引き起こすノイズの低減のための界面創製

高井 まどか氏 東京大学 大学院工学系研究科 教授



Abstract:

Non-specific biomolecules adsorption such as proteins and cells are the cause of noise of biosensor and bioelectronics therefore reduction of adsorption is important to improve the functions. We have developed the biointerfaces to reduce the protein and cell adhesion by using the biocompatible polymers composed of phospholipid moiety which is bioinspired materials coming from cell membrane. The inhibition ability of biomolecules adsorption is strongly depended the chemical and physical and also structural properties of the biocompatible polymer. Hydrophilic, non-charged properties and also uniform structure are necessary functions to reduce the noise. The biocompatible polymer technology is the promising for microfluidics biodevices and also micro-biosensors that can use in vivo.

Biography:

Madoka Takai is a Professor of Department of Bioengineering at The University of Tokyo from 2011. She received B.Eng. M.Eng. and PhD in Applied Chemistry from School of Fundamental Science and Engineering, Waseda University. She worked for Toshiba Corporation during 1990-1991. After getting the PhD at 1998, she was a Research Fellow, Japan Science and Technology Agency, and worked as "Plasma chemistry for amorphous silicon solar cell". From 2001 she moved to Department of Materials Engineering, School of Engineering, The University of Tokyo as a research associate, and then she got the associate professor of Department of Materials Engineering, School of Engineering, The University of Tokyo at 2003. Her interest is basic interface between biomolecules or cells and materials, and development of nano-materials for biomedical devices, such as implanted artificial organ, biosensor, microfluidics devices. She received Award of research achievement for female researcher, "leading research of biosensor and novel biomaterials" The Japan Society of Applied Physics, 2012, Outstanding Researcher Award on Chemistry and Micro-Nano Systems, "Study on highly sensitive bioanalysis by functionalization of microchip" Chemistry and Micro-Nano Systems, 2010.

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