

# 2016 2<sup>nd</sup> AFRL Workshop on Beta-Ga<sub>2</sub>O<sub>3</sub> Synthesis, Characterization and Applications

Drs. Gregg Jessen; Ken Goretta | December 12-13, 2016 | Arlington, VA

Basic Research Innovation and Collaboration Center (BRICC)  
4075 Wilson Blvd., Suite 350 | Liberty Room  
Arlington, VA 22203

## Agenda Day 1 | December 12, 2016

| Time        | Title   | Speaker   |
|-------------|---|---|
| 7:30        | Registration  |   |
| 8:00-8:10   | Introduction and US Perspective                                     | Dr. Gregg Jessen (AFRL)   |
| 8:10-8:20   | Ga <sub>2</sub> O <sub>3</sub> Fundamental Science Perspective      | Dr. Ali Sayir (AFOSR)   |
| 8:20-9:00   | Global Snapshot   | Dr. Masataka Higashiwaki (NICT Japan);<br>Dr. Michele Baldini (IKZ Germany)   |
| 9:00-10:00  | Epitaxy and Opportunities Afforded by Native Substrate Availability | Discussion Lead Prof. Jim Speck (UCSB): < 15 min + 45 min open discussion   |
| 10:00-10:10 | BREAK   |   |
| 10:10-11:10 | Electronic Transport and Devices                                    | Discussion Lead Prof. Debdeep Jena (Cornell): < 15 min + 45 min open discussion   |
| 11:10-12:25 | LUNCH ON YOUR OWN   |   |
| 12:25-13:25 | Materials Characterization and Challenges                           | Discussion Lead Dr. Steve Ringel (OSD): <15 min +40 min open discussion   |
| 13:25-14:15 | Modeling and Simulation   | Discussion Leads Dr. Stefan Badescu (AFRL) and Dr. Eric Heller (AFRL): 10 min atomistic + 10 min device sim + 30 min open         |
| 14:15-14:15 | BREAK   |   |
| 14:25-15:05 | Commercial Materials and Reactor Development                        | Open forum for providers of Bulk Substrates, Epitaxial Materials, Reactors with opening remarks by Dr. Akito Kuramata (NCT Japan) |
| 15:05-15:35 | Applications  | Industry Application Discussion   |
| 15:35-17:00 | Summary and Identification of Knowledge Gaps                        | Group Activity  |

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|--------------------|---|--|
| <b>17:00</b>       | <b>MEETING ADJOURN FOR THE DAY</b>  |  |
| <b>17:45-19:45</b> | <b>Social:</b> The Front Page<br>4201 Wilson Blvd., Arlington, VA 22203<br>703-248-9990 | <a href="http://www.frontpagearlington.com">www.frontpagearlington.com</a> |

| <b>Technical Discussion Topics Day 1   December 12, 2016</b>                              |                             |
|---|-----------------------------|
| <b>Topic</b>  | <b>Speaker/Organization</b> |
| <b>Overview</b>   |                             |
| Introduction  | G. Jessen, AFRL             |
| Ga2O3 Fundamental Science Perspective   | A. Sayir, AFOSR             |
| The Rise of Ga2O3 for a New Era of Power Electronics                                      | M. Higashiwaki, NICT        |
| Growth of Homoepitaxial $\beta$ -Ga2O3 Layers by MOVPE for Power Electronics Applications | M. Baldini, IKZ             |
| <b>Epitaxy and Opportunities Afforded by Native Substrate Availability</b>                |                             |
| Ga2O3 Materials Synthesis by MBE  | J. Speck, UCSB              |
| Non-polar GaN Epitaxy on (010) Ga2O3  | Y. Cao, HRL                 |
| Synthesis and Characterization of LPCVD beta-Ga2O3 Films                                  | H. Zhao, CWRU               |
| CZ Growth of beta-Ga2O3   | D. Thomson, AFRL            |
| <b>Electronic Transport and Devices</b>   |                             |
| Gallium Oxide Electronic Devices  | D. Jena, Cornell            |
| High-Voltage E-mode and High-Current D-mode FETs  | K. Chabak, AFRL             |
| Transport and Doping in Ga2O3 Transistors   | S. Rajan, OSU               |
| Electronic Transport Characterization of beta-Ga2O3                                       | S. Mou, AFRL                |
| Record Drain Currents on GOOI D/E-modes FETs  | P. Ye, Purdue               |
| Ga2O3 Schottky diodes on MBE and HVPE epi   | A. Corrion, HRL             |
| Ga2O3/Dielectric Interface Characterization and Transport in Ga2O3                        | U. Singiseti, U. Buffalo    |
| <b>Materials Characterization and Challenges</b>  |                             |
| Ga2O3 Materials Characterization  | S. Ringel, OSU              |
| Characterization of beta-Ga2O3 Contacts and Interfaces                                    | L. Porter, CMU              |
| Growth and Characterization of Homo- and Heteroepitaxial beta-Ga2O3 thin films            | M. Tadjer, NRL              |
| Low-Ohmic Contact and Hall Sampling on MBE, VPE, LPCVD Materials                          | A. Green, WYLE              |
| Characterization of $\beta$ -Ga2O3 MOS Capacitors with High-k Dielectrics                 | C. Young, UT Dallas         |

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|---|-----------------------|
| Interfaces in Ga2O3 Power Semiconductor Devices   | S. Choi, Penn State   |
| <b>Modeling and Simulation</b>  |                       |
| Ga2O3 Atomistic Modeling  | S. Badescu, AFRL      |
| Device Level Modeling and Thermal Simulations with Sentaurus Device                                     | E. Heller, AFRL       |
| GW Results for beta-Ga2O3 including Lattice Polarization Corrections and the Absorption Edge Anisotropy | W. Lambrecht, CWRU    |
| Ab initio Simulations on Controlling the Conductivity in Ga2O3  | J. Varley, LLNL       |
| <b>Commercial Materials and Reactor Development</b>   |                       |
| Ga2O3 Materials and Commercial Availability   | A. Kuramata, NCT      |
|   | D. Hanser, Veeco      |
| Growth of Bulk Single Crystal Gallium Oxide   | K. Stevens, Synoptics |
| HVPE Capabilities and Ga2O3 Growth Tool Development   | J. Leach, Kyma        |
| Ga2O3 MOCVD Tool Hardware and Process Issues  | G. Tompa, SMI         |
| 5 um per hour Growth Rates of High Quality b-GaO by MOCVD   | A. Osinsky, Agnitron  |
| <b>Summary and Identification of Knowledge Gaps</b>   |                       |

| <b>Agenda Day 2   December 13, 2016</b> |  |   |
|---|--|---|
| <b>Time</b>                             | <b>Title</b>                               | <b>Speaker</b>  |
| <b>7:30</b>                             | <b>Registration</b>                        |   |
| <b>8:00</b>                             | Rehash and Discussion on Application Space | This is a forum where non-proprietary application oriented discussions are encouraged and may include ITAR/EAR information. |
| <b>9:00</b>                             | Reserved by appointment                    |   |
| <b>9:20</b>                             | Reserved by appointment                    |   |
| <b>9:40</b>                             | Reserved by appointment                    |   |
| <b>10:00</b>                            | Break                                      |   |
| <b>10:10</b>                            | Reserved by appointment                    |   |

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|--------------|-------------------------|---|
| <b>10:30</b> | Reserved by appointment |   |
| <b>10:50</b> | Reserved by appointment |   |
| <b>11:10</b> | Reserved by appointment |   |
| <b>11:30</b> | Break                   |   |
| <b>11:40</b> | <b>Gov't Caucus</b>     | Gov't only discussion on program coordination and technical direction |
| <b>12:45</b> | <b>MEETING ADJOURN</b>  |   |