ORF-RE PROJECT NEWSLETTER

Enabling Next-Generation Devices through Novel Molecule-Based Thin Film Deposition Methods and Advanced Characterization of Structure and Function

Issue 2, June 2020

Ontario Research Fund

EXECUTIVE SUMMARY

YEAR 2 PROGRESS

Welcome to the second edition of our ORF-RE Project newsletter. The end of Year 2 fell into the midst of the COVID-19 pandemic. It has been a year of unexpected disruption.

At the beginning of Year 2, a critical initial step, construction and programming of the new ALD reactors, is well underway. We have received our orders for all of the large and most of the small items, and the first couple of rounds of orbital welding are complete. Larger items include hazardous gas cylinder cabinets, a vented enclosure for the reactors, dry vacuum pumps, an abatement system, and ovens to house the reactors and heated bubblers, which have been successfully installed in the ALD room located on the 4th floor of ABB. Smaller items include ConFlat and VCR fittings, various valves, feedthroughs and flanges, mass flow controllers, a lot of stainless steel tubing, solenoid manifolds, various National Instruments hardware, ALD bubblers, vacuum gauges, regulators, gas purifiers, and gas sensors.

The initial goal from Year 1 was for the ORF-RE ALD reactors to be operational in October 2019, and tested and ready for use shortly after, along with a prototype ALD reactor from a partner company. However, due to unexpected delays from associated renovations and the delivery of some components, this initial goal was pushed back to Spring/Summer 2020. Unfortunately, all on-campus activities at McMaster University were then restricted due to the province-wide lockdown, and similar limitations applied to our collaborators globally. At McMaster, we have gone through Phase 0 – where all research labs were shut down (for almost 3 months) except those pertaining to COVID-related research – to a modified Phase 1, where only half of the research capacity is allowed.

Even in this unprecedented time, we welcomed two new members to the ORF project within the past year. Dr. Zoya Sadighi (postdoctoral fellow) joined the Goward group in April 2020, working on novel polymer electrolytes and their characterization and optimization, and Nick Hoffman (MSc student) joined the Emslie group in September 2019, focusing on the development of precursors for late transition metal ALD. More details on all student and PDF ORF members are provided on page 2.

We are hopeful that we can get through this pandemic safely, and are excited for an productive upcoming year.

David Emslie

STUDENTS AND POSTDOCS

ALD Precursor and Reactivity Development

Jeffrey Price started his chemistry journey in the Emslie group in his undergraduate study and obtained his PhD in 2018. He continued as a postdoctoral fellow in Jan 2019. His research targets highly reactive new organometallic ALD precursors.

Kevin Yu graduated with his PhD from Shantou University in China in 2018. He joined the Emslie group as a postdoctoral fellow in June 2019. His research centres around the development of novel co-reactants for transition metal ALD.

Majeda Al Hareri obtained her BSc in Chemistry from Brock University, and started as a graduate student in the Emslie lab in Sept 2016. She was awarded an NSERC PGS-D in 2018. Her research is focused on main group element and metal oxide ALD.

Nick Hoffman obtained his BSc in Chemistry from the Western University. He started as a graduate student in the Emslie lab in Sept 2019. He was awarded an NSERC CGS-M scholarship in 2020. His research focuses on the development of late transition metal ALD.

Jocelyn Sinclair obtained her BSc in Chemistry from Dalhousie University. She is currently a graduate student in the group of Eric Rivard at the University of Alberta. Her research involves group 14 complexes and their applications in thin film deposition.

Xiuping Ding joined the Moran-Mirabal group as a PhD student in 2016. Her work focuses on the development of stretchable electronic devices and solar cells.

Optical and Electrical Device Fabrication and Characterization

Josh Kneller obtained his BSc in Engineering Physics at McMaster University, and he joined the Xu Group in 2017 working towards his PhD. His research focuses on the development and applications of mid-IR lasers.

Tyler Kashak obtained his BSc in Engineering Physics at McMaster University, and he joined the Xu Group in 2019 as a MASc student. His research focuses on the development and applications of compact stolid state lasers.

Annica Freytag obtained her MSc from Queen's University in Chemistry. She joined the Goward group in 2016 as a PhD student. Her research focuses on advancing techniques for in-situ monitoring of full electrochemical cells.

Zoya Sadighi obtained her PhD in Mechanical Engineering and Aerospace from The Hong Kong University of Science and Technology. She joined the Goward group in April 2020 as a postdoctoral fellow. Her research focuses on solid-state battery development.

Khadijeh Miarabbas Kiani received her Masters in Electrical Engineering, Electronics from Shiraz University, Iran. She joined the Bradley Group as a PhD student in 2018, studying photonics, silicon photonics, nanophotonics, etc.

Cameron Naraine received his BSc in Physics from Wilfrid Laurier University in 2018 and is now a MASc student in Engineering Physics at McMaster University. His research interests include design and simulation of silicon photonics systems.

Past Members

Declan DeJordy obtained his MSc in Chemistry from McMaster University in 2020. His work focused on the investigation of early transition metal complexes for ALD applications.

Jeremy Miller, obtained his PhD in Engineering Physics from McMaster University in 2020. He is now a Mitacs Postdoc in collaboration with Intlvac under the supervision of Profs. Bradley and Mascher.

Declan working in the Glovebox

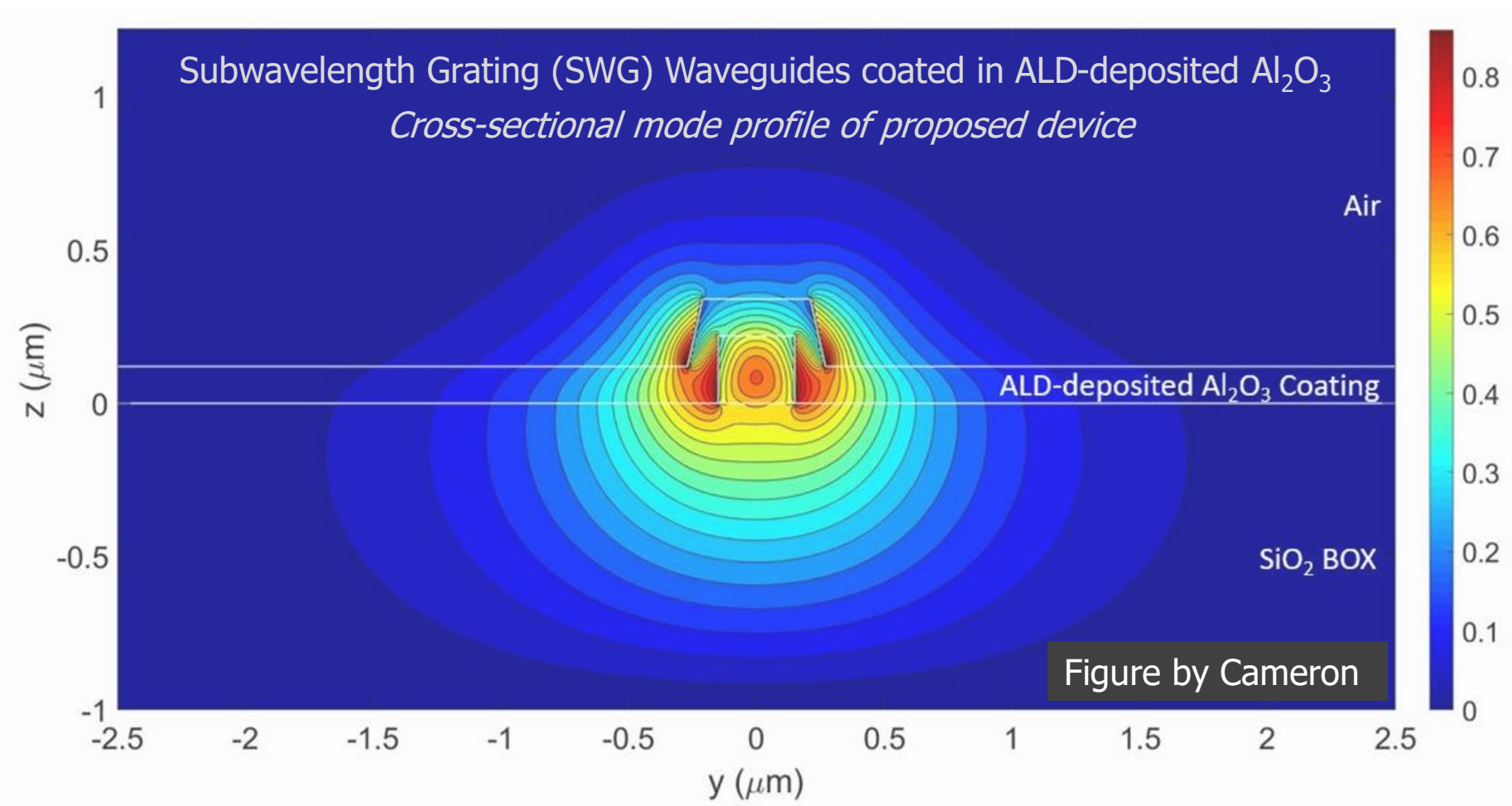
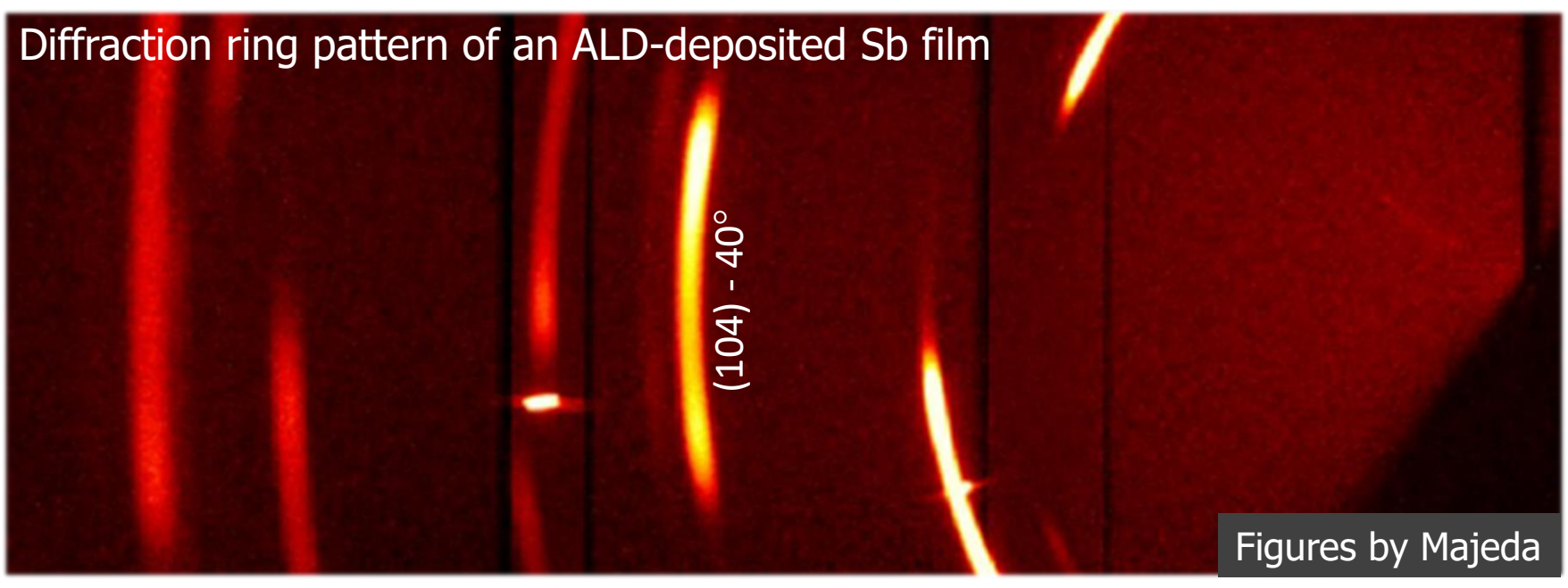
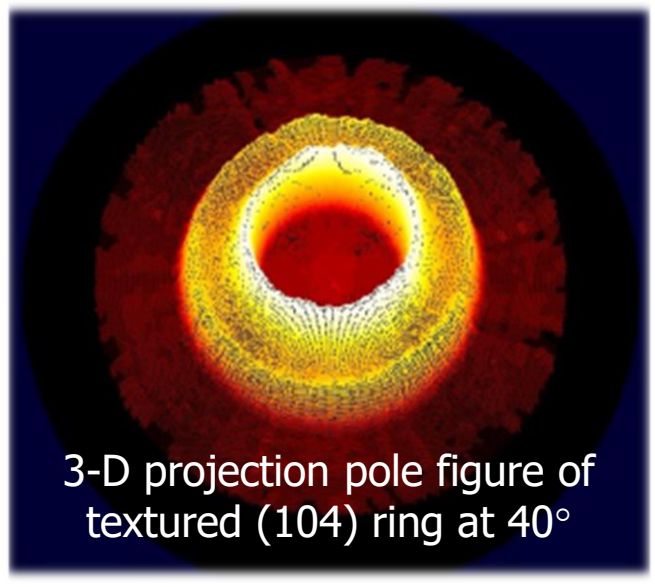


Figure by Cameron



Figures by Majeda



3-D projection pole figure of textured (104) ring at 40°

RECENT EVENTS

Year 1 Welcome & Kick-Off Social

The first kick-off social was held in September 2019 at the Phoenix Bar & Grill at McMaster University.

McMaster ALD Precursor and Reactivity Development Subgroup

April, 2020 at McMaster University
Chaired by: D. Emslie

Thank you to all participants!

RECENT PUBLICATIONS

J. M. Moran-Mirabal, J. Vapaavuori, *et al. ACS Appl. Energy Mater.* **2019**, *2* (8), 5635–5642.
https://doi.org/10.1021/acsaem.9b00795

G. R. Goward, *et al. J. Am. Chem. Soc.* **2019**, *141* (35), 13758–13761.
https://doi.org/10.1021/jacs.9b06885

J. D. B. Bradley, *et al. Opt. Lett.* **2019**, *44* (23), 5788–5791.
https://doi.org/10.1364/OL.44.005788

J. M. Moran-Mirabal, *et al. ACS Appl. Nano Mater.* **2019**, *2* (7), 4169–4179.
https://doi.org/10.1021/acsanm.9b00640

ACKNOWLEDGEMENTS

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ORF Website (NEW!):
https://emsliegroup.mcmaster.ca/orf-re