THE UNIVERSITY OF HONG KONG

DEPARTMENT OF MECHANICAL ENGINEERING

SEMINAR

Online

Title: **Development of organic thin-film transistors for high-frequency applications: A battle against high contact resistance**

Speaker: **Dr. James W. Borchert**
University of Goettingen
Germany

Date: **10 February, 2021 (Wednesday)**

Time: **4:00 p.m. (Hong Kong Time)**

Zoom meeting: **1) Link to join the meeting:**

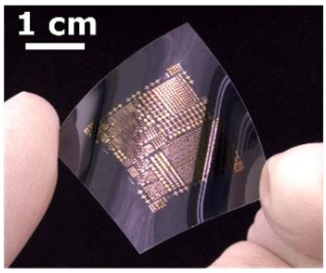
https://hku.zoom.us/j/91579786863?pwd=Qm1NOFFKdXFYcXRqVmljUVlBd1g4Zz09

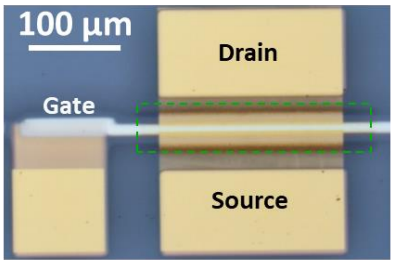
2) Meeting ID: 915 7978 6863

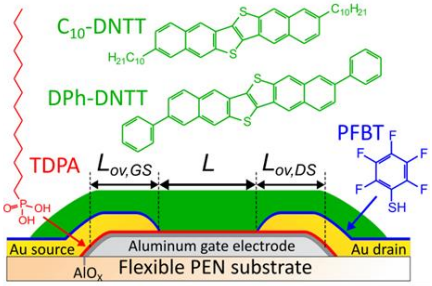
3) Password: 691074

Abstract:
Organic semiconductors have been implemented in a variety of electronic devices ranging from organic light-emitting diodes, organic solar cells, and organic transistors. As is true for other semiconductor technologies, the efficient injection and/or extraction of charges across interfaces with conducting contacts is an essential requirement for device performance of organic electronics. Like 2D semiconductors, high contact resistance is a major problem in organic transistors, since it directly limits their usefulness in potential high-frequency electronics applications. The contact resistance can depend strongly on various parameters, including the transistor architecture and the mismatch

between the contact work function and the transport levels of the organic semiconductor. In our work, we have shown how using a thin gate-dielectric layer (around 5 nm) in a coplanar thin-film transistor (TFT) in combination with contacts modified using a chemisorbed monolayer to tune the contact-semiconductor interface properties yields record-low contact resistance as small as 10 Ωcm and subthreshold swings as low as 59 mV/decade in low-voltage organic transistors fabricated on flexible substrates. This approach was then extended to small-scale TFTs and circuits leading to additional record results in the dynamic performance, including voltage-normalized transit frequency up to 7 MHz/V. While these latest results as well as developments from other groups including the first ever demonstration of a transit frequency above 100 MHz have revitalized the efforts to realize commercially viable high-frequency organic transistors, the quest for 1 GHz will require further improvements in the understanding and mitigation of contact resistance and advances in the device fabrication.







Biography:

James W. Borchert received a Bachelor of Arts degree in physics from Rutgers University in 2012 and a Master of Science in Engineering degree in Materials Science and Engineering from the University of Pennsylvania in 2013. From 2014 to late 2015 he worked as a Staff Scientist at Innova Dynamics in San Francisco, California, USA. In August

2020, he successfully completed the Ph.D. degree in materials science under the advisement of Dr. Hagen Klauk at the Max Planck Institute for Solid State Research and Prof. Dr. Sabine Ludwigs at the Institute of Polymer Chemistry at the University of Stuttgart. During his Ph.D. studies, James focused on the interface physics and fabrication of organic thin-film transistors to enable their use in high-frequency circuit applications. His work has so far led to the recent development of state-of-the-art low-voltage, flexible organic thin-film transistors that currently hold records for several device performance metrics including voltage-normalized transit frequency and contact resistance. He has presented at several internationally recognized scientific conferences, including the prestigious International Electron Devices Meeting (IEDM) in 2018. He is now a Postdoctoral Researcher in the group of Prof. Dr. R. Thomas Weitz at the University of Goettingen, Germany, where he continues to investigate the interesting physics of organic semiconductors and to develop other novel nanoscale electronic devices.

ALL INTERESTED ARE WELCOME

For further information, please contact Dr. P.K.L. Chan at 3917 2634.

Research area: Energy