MEng Project CHESS-7: Control engineering for the processing of advanced functional materials

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For the next generation of flexible electronics research the focus will be on developing and understanding of coating and printing methods, to facilitate transfer of lab-based synthesis and deposition methods to the production line. A large number of soluable organic semiconductor materials have been developed over the past decade, and materials have reached critical limits of mobility (organic transistors/flexible electronics) and efficiency (organic solar cells). Depositing materials from the solution phase offers the potential of low-cost and low-energy processing at close to ambient temperatures and pressures.
A large variety of coating and printing techniques has been developed in industry in the past hundred years, and very sophisticated equipment is available. However, the coating and printing processes have to be tuned to the requirements of functional materials. Specifically all of these materials have self-assembly properties, and coating or annealing processes need to be fine-tuned, to bring out the best of the materials under reasonable production conditions.

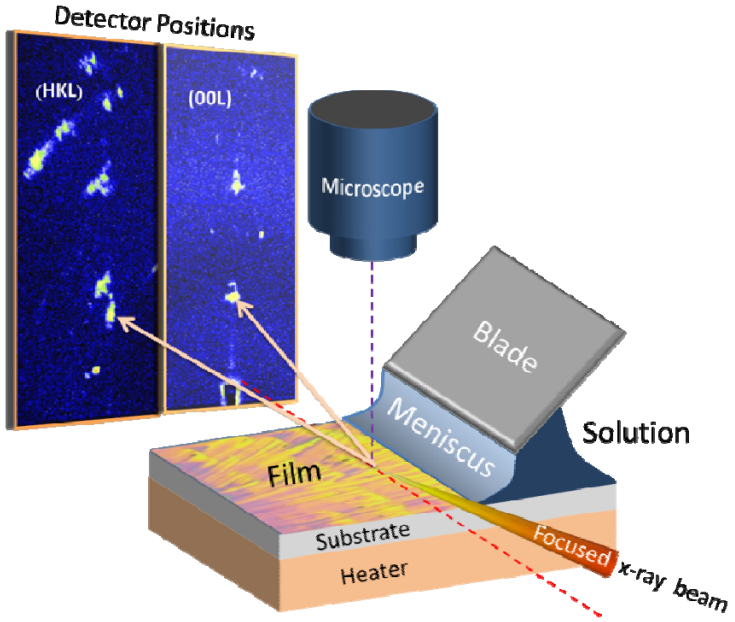

Figure: In-situ knife-coating studies of an organic semiconductor with real-time x-ray movies of the crystallization process. (Smilgies et al., PSS-Rapid Research Letter 2013, Vol. 7, 177-179).
At my instrument we can probe the self-organization processes during coating and annealing steps in-situ and in real time, making use of the intense x-ray beams produced by the Cornell storage ring. Coordinating coating and annealing processes with the x-ray data acquisition requires development of software and processing conditions. In previous MEng projects we have developed coating stages, thermal annealing stages, a solvent vapor control system, and a preliminary platform for interfacing instruments based on LabView. I am looking for a student interested in further developing these control applications that will be essential for the development of the beamline capabilities. The student will have to possibility of testing his/her

developments at the beamline, within specific commissioning projects and/or in collaboration with internationally renowned user groups. Of high priority are the further development of solvent vapor and thermal processing of functional organic thin films, as well as instrument control for a miniature slot-die coater at the beamline.
CHESS is a national user facility with state-of-the-art beamline instrumentation, servicing hundreds of national and international users per year. CHESS staff scientists are responsible for supporting user experiments as well as keeping instrumentation at the forefront of science. CHESS also has an outreach and teaching mission. In my teaching I work with MEng students on their projects and try to give them a perspective of scientific method and thinking beyond the classroom. Lab space for technical development is available in the CHESS Sample Environment Lab. I am looking for a chemical engineering masters student with interest in programming and computer-interfacing of instruments in an exciting field of science and technology. Goal of the study would be to develop code, test the code, and write documentation (as the final report).
In case you are interested, please contact me at dms79@cornell.edu.

See also the CHESS News article on the first three graduating MEng project students:
http://news.chess.cornell.edu/articles/2015/Smilgies150105.html

Suggested Reading:
MEng Project reports by George Guo (temperature control) as well as Vincent Rosa and Zhenyang Wang (solvent vapor control).