MEYER BURGER

Manipulation and control of spatial ALD layers for flexible devices

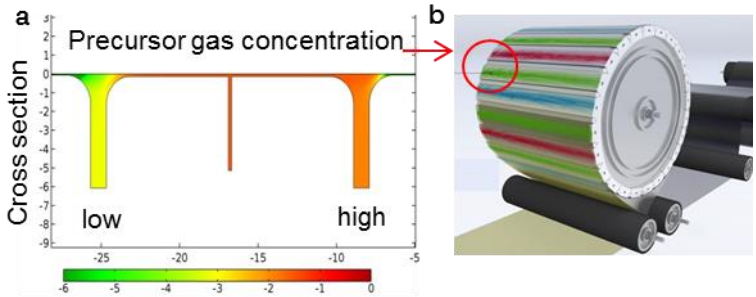
During the past years there has been an increasing interest for flexible materials with advanced functionality. A new generation of flexible electronics can benefit from accurate control of coating thickness and material properties and also from combined inorganic/organic coating methods that can be integrated in one system. To serve this purpose, we have developed in collaboration with leading institutes in the Netherlands an innovative system that combines a highly controlled spatial ALD deposition system with a coatings step of an organic-based layer of method of choice, either patterned or fully covered.

Special attention has been given to designing a scalable segment-based injector head that can be applied for a roll-to-roll configuration but also for a rotary reactor. Moreover, this design allows for scalability in width but also in process speed and in the choice of precursor materials if a multilayer-like deposition configuration is envisioned. From gas flow modelling on a COMSOL platform insight into the foil transport and gas separation has been gained which could be directly transferred into the design of the equipment.

We will present how roll-to-roll spatial ALD enables production of high performance barrier foil which can be used to protect sensitive flexible electronics like OLEDs, thin film (O)PV and quantum dot foils. We will explain the basics of spatial ALD, the challenges of scaling up to industrial production and present an evaluation of the barrier and optical properties of deposited barriers.

While a barrier of only 20 nm aluminium oxide (AlO_x) does not change the foil optically, calcium degradation tests as well as MOCON-like measurements reveal a water vapor transmission rate as low as $6 \cdot 10^{-5} g/m^2/day$ at 20°C and 50% relative humidity. Such an AlO_x barrier is roll-to-roll deposited on regular 125 micron PET foil without any additional treatment.

The versatility of the roll-to-roll spatial ALD system is ideal for process and equipment development and represents an important milestone for fabrication of flexible solutions for various industries. Additional to barrier foils, such a system can also be used to deposit buffer layers and conductive oxides for CIGS, oxide semiconductors for TFT's or electrode materials for batteries. Moreover, with all processes at atmospheric pressure, we have opened the way to low cost production of flexible materials with advanced functionality.



(a)COMSOL simulations of precursor gas flows. (b)Schematic of ALD drum.

Flex R2R platform: pilot production system for roll-to-roll spatial ALD.

Biography:
Edward Clerkx is heading the business unit Thin Film Coating within Meyer Burger (Netherlands) B.V. He has a background in engineering and 20 years experience in industrializing process equipment. Since 5 years he is active in the field of barrier and encapsulation equipment with a focus on the flexible electronics market.

Keywords:
ALD, flexible electronics materials, simulations, R2R, production systems