



Roll-to-roll Vacuum processed Carbon Based Electronics (RoVaCBE)

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Electronics components that can be manufactured using roll-to-roll processing offer the possibility of lower cost devices as well as those that might be mechanically flexible in use. Roll-to-roll (R2R) processing, using a flexible substrate (typically a polymer film) allows for cheap production of many components very rapidly, with low energy requirements. Key areas of exploitation of this technology include flexible displays, but there is also a wealth of lower-cost applications. Tagging and tracking of fast moving consumer goods is an example technology that truly exploit the very low-cost nature of the production and in which the manufacturing is closely linked to the manufacturing routes currently exploited for e.g. packaging technologies. Carbon based electronics (CBE) based on polymer and/or organic molecular materials has been identified and a high priority development area, and much interest in research to date has focussed around solvent-based processing.

This proposal seeks to exploit the existing industrialised technology of vacuum R2R processing, widely used for example in the packaging industry, to develop the manufacture of very low cost organic field-effect transistor (OFET)-based devices and circuits. This manufacturing route, like solvent based systems, is cheap and provides flexible product, and we can exploit high electrical mobility molecular semiconductors. Additional advantages of the solvent-free vacuum processes include: a) likely enhanced web-speed, b) integration with vacuum-based metal deposition for conducting channels, and metal or ceramic deposition for barrier layers and possible interfacial modification, and c) the ability to deposit multiple thin layers to build up device structures without solvent interactions with underlying layers.

The project will exploit our existing R2R web processing facility to explore the principal manufacturing challenges to R2R vacuum production of OFET devices: 1) selection and adaptation of materials to vacuum deposition integrated with design of suitable circuitry, 2) patterning of the semiconductor and insulator layers to allow the formation of circuit connections between devices and 3) reliability of manufacture to be able to produce arrays of multiple transistors for circuits. It will allow us to explore and develop the deposition of molecular semiconductor and dielectric materials and then the subsequent reliability and thermo-mechanical resilience of the resulting product such that it might need to withstand, for example, during a lamination process.