ABSTRACT

The construction of Organic Light Emitting Diodes (OLEDs) and Organic Photovoltaics (OPVs) led to a real revolution in optoelectronic and energy industries and technologies. These organic systems are deposited on rigid substrates, usually on glass, with a result of lower functionality and applications. The current trend is the replacement of these rigid substrates with flexible polymeric materials. The most important advantage following this replacement is the new potentials of applications and construction methods. They can be constructed easier, faster and cheaper with roll to roll (r2r) processes and their applications will be expanded. However, the most important problem that should be overcome for a profitable mass production and use is the small lifetime of these devices. The organic layers and the electrodes are very sensitive against oxygen and water vapors and that decrease the lifetime of the devices. Due to the fact that the polymer substrates have a quite big permeability rates in oxygen and water vapors, new high barrier systems must be constructed. The most effective way achieving this is the deposition of transparent inorganic high barrier films on these substrates and the creation of alternative organic/inorganic layers. The present thesis has as main aim the study of two polymer substrates (PET and PEN) and a hybrid substrate (ORMOCER) and the deposition on these substrates of high barrier thin films of non-stoichiometric silicon oxide (SiO_x). The thesis is constituted of two parts.

The first part is the theoretical part and is divided in six chapters. In the first chapter is mentioned the basic principal functions of OLEDs and OPVs. The second chapter includes some information for high barrier thin films and the ways of measuring the permeability of a membrane. The next chapter includes the physics of thin films and the vacuum types. In the fourth chapter is mentioned the materials that can be used as high barriers and especially these materials that were used in this thesis. Chapter five contains the permeability theories and the description of multilayer high barrier systems. Finally, in chapter six is set out the theoretical background of the experimental techniques that were used in this thesis.

The second part of this thesis is the experimental part where the results were discussed. In chapter seven is the electron beam deposition technique and the experimental conditions of the depositions. Chapter eight contains the information of infrared spectroscopic ellipsometry and chapter nine includes the permeability results. Chapter

ten includes the experimental results for the wetting properties of the membranes. In chapter ten there is also a detailed description of goniometry system for contact angle measurements. Chapter eleven includes the results from X-ray diffractometry and in the final chapter (chapter twelve) is mentioned the results from the Nanoindentation measurements.

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