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Stochastic Algorithms Applied to the Optimization of Multi-layer OLEDs

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Abstract – Organic light emitting diodes (OLED) constitute a new class of emissive devices, which present high efficiency and low voltage operation, among other advantages over current technology. Multilayer architecture (M-OLED) is generally used to optimize these devices, specially overcoming the suppression of light emission due to the exciton recombination near the metal layers. The massive number of possible model configurations, however, suggests that a search algorithm would be more suitable for this matter. In this, work different stochastic algorithms such as, Genetic Algorithms, Particle Swarm Optimization and Ant Colony Optimization were applied in order to optimize Multi-layer OLEDs.

OLEDs (organic light-emitting diodes) consist of emissive organic materials that, when supplied with an electrical current, can produce a superior full-color display. One of the several factors that make OLEDs superior to LCD technology is the fact that they do not require backlighting, thus allowing them to operate with less power, yet without bringing down brightness or contrast quality. Furthermore, such displays can be clearly viewed at practically any angle. However, several drawbacks have limited the efficiency of OLEDs. Recently a new and improved methodology was proposed to avoid these difficulties. In this case a multilayer device has been developed with graded concentration in the emissive layer, showing an improvement in the electroluminescence efficiency [1].

Based on the multilayer with graded concentration cited before and on a previous work to model single layer devices [2], an analytical model to optimize the electrical behavior of the emissive region of the graded multilayer OLED devices was presented [3]. The massive number of possible model configurations, however, suggests that a search of an algorithm would be more suitable for this matter. The aim of this work is to compare a set of stochastic algorithms, such as Genetic Algorithm (GA), Particle Swarm Optimization (PSO) and Ant Colony Optimization (ACO) to find the best optimized concentration of ETM and HTM on each graded layer of the device.

Stochastic optimization (SO) is based on probabilistic choices and does not include the calculations of derivatives. As we cited before, this work compares three different algorithms. GA is a parallel algorithm based on genetic inheritance and Darwinian strife to survival. PSO is also a parallel algorithm and is based on social-psychological principles and collective behavior, such as bird flocks and fish schools. ACO is similar to PSO, however is based on the behavior of an ant colony and their way to record paths.

The first results achieved have shown a significant enhancement on the efficiency of the multilayer OLED devices. Figure 1 shows the comparison between a device optimized by a GA and a previous one proposed on the literature.

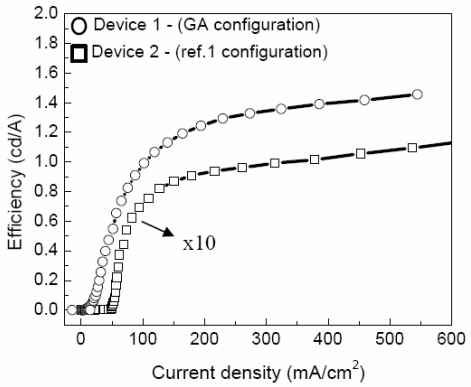

Figure 1: Comparison between optimized device by GA and a previous design one.

References

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