Simulation of light extraction from OLEDS with FDTD Solutions

Introduction:

Organic light emitting diodes (OLEDs) are a class of solid-state light sources that have been around for over two decades. They are based on conjugated polymers or small molecules that emit light when excited by an electron-hole pair, making them ideal for backlighting applications in displays. The optimization of OLEDs for maximum light extraction is crucial for their performance. This research focuses on simulating light extraction from OLEDs using the finite-difference time-domain (FDTD) method. FDTD Solutions 6 is a state-of-art commercial software that allows for the solution of Maxwell’s equations for complex structures with metal materials.

Modelling light extraction from OLEDs:

In an OLED, electrons and holes recombine to emit light. The extraction of this light is crucial for the performance of OLEDs. The FDTD method is used to model light extraction from OLEDs, considering the light emitted from the OLED structure. The results show that about 30% of the generated photons remain trapped in the glass substrate and 50% in the organic layers. This indicates that enhancing light extraction would enable higher efficiency and longer lifetime.

Simulation of light extraction with FDTD Solutions:

FDTD Solutions 6 is a software package that solves the Maxwell equations for complex geometries and materials, including metals. It allows for the simulation of light extraction from OLEDs. The extraction efficiencies, far-field distributions in the substrate, and the electrical and magnetic fields are calculated. The software also allows for the calculation of the light trapping in a generic OLED structure and the propagation of light is shown to flow into the OLED structure and then into the substrate.

Results:

• Device simulation with commercial FDTD solutions and angular distributions agree reasonably well with measurements obtained from devices in the literature.
• By using the new software, the simulations can be greatly simplified. The software can simulate light distribution in space and time to simulate incidence in our experience of space and time.

Conclusions:

The combination of powerful simulation programs like FDTD Solutions and microelectronic circuit insights is a powerful tool to understand light extraction processes from OLEDs with tunable efficiency and performance, achieving optimal efficiencies for a given product.

References: