FESC
Florida Energy Systems Consortium

University of South Florida

Development of a Smart Window for Green Buildings in Florida

(Final Report)

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Description: The microwave plasma system was used to grow nanophosphors of La2O3:Bi and CaS:Eu. The system was modified to accommodate chemical vapor deposition (CVD) of ZnO and ZnS. ZnO coatings where grown by introducing Zinc acetylacetonate (Zn(acac)2) vapor as precursor near the substrate. Vapor was generated by heating granules of Zn(acac)2 in a container to 160^{o}C and pushing the vapor with gas that contained a mixture of Ar and oxygen. Imethilzinc and H2S were used for the growth of ZnS films.

Microwave plasma process allows control of nanophosphor particle sizes by controlling the precursor concentration. We have demonstrated the ability to deposit La2O3:Bi nanophosphors in single crystal form with sizes from 5nm to 100 nm by changing the starting concentration. Transmission Electron Microscopy (TEM) showed the hexagonal crystals and clear lattice planes with d=3.34Å that corresponds to (100) orientation. BTO layer required for the device structure was sputter deposited at low temperature.

Radiant flux emitted by devices fabricated with the conventional EL structures and devices with the proposed structures were measured by the integrated sphere technique. Measured values confirmed the enhancement in emission resulting from the proposed structure. The observed upward trend confirms the viability of the concept and the potential of EL devices fabricated under optimum conditions to reach desired outputs of 1300-1500 μW (13-15 W/m2).

Executive Summary:

This project is aimed at developing a smart window concept that has the potential to convert part of the solar radiation falling on windows during daytime to electricity, and to use this harnessed energy to power a phosphor-based, highly efficient white-light LED source to illuminate the building at night. This project pursues two different technologies: (1) use of quantum dot based solar cells to harvest solar energy, and (2) develop an electroluminescent light source based on nanophosphors to provide illumination for buildings. The project brings together two unique nanoparticle growth techniques developed at the Laboratory for Advanced Material Science and Technology (LAMSAT) at USF to fabricate a prototype device that would demonstrate the possibility of significant energy savings. Research acomplishements related to solar device was presented in last annual report. This report focuses on research developments in the solid state lighting device.