There is considerable interest in the development of epitaxial $BaTiO_3$ ferroelectric thin films for integrated optic and micro-photonic applications. Recently we have shown that Er-doped $BaTiO_3$ waveguides exhibited stimulated emission upon optical pumping. Further increases, however, in the luminescence efficiency are required if it is to be used as an optical gain medium. The luminescent properties of Er-doped $BaTiO_3$ thin films prepared by MOCVD were investigated. It was noted that the characteristic Er-related luminescence intensity at 1.54 microns depended upon both deposition conditions and post-deposition processing. To determine the factors influencing the intensity, the Er-doped films were annealed at high temperatures in oxygen. The characteristic luminescence intensity increased as much as twenty-fold upon annealing. The increase in intensity is tentatively attributed to the activation of the Er centers. The influence of annealing on the lifetime of the optically excited Er center was also studied using transient photoluminescence. Radiative lifetimes of 8 ms were measured. A model for the luminescence efficiency was developed and will be described.

**11:00 AM, FF3+**

**Single-Layer Polymer Blend Organic Light Emitting Diodes with Electron Transport Polymers**: K. A. Killeen[2]; T. R. Hebner[1]; F. Pschenitzka[1]; M. H. Lu[1]; M. E. Thompson[2]; J. A. STURM[1]; [1]Princeton University, Dept. of Electrical Engineering, Engineering Quadrangle, Princeton, NJ 08544-5263 USA; [2]University of Southern California, Department of Chemistry, Los Angeles, CA 90089 USA

One structure for the wet processing of organic light emitting diodes (OLEDS) which has exhibited great promise are polymer blends, in which emissive, and carrier transport agents are blended into a host polymer. Most previous work focused on blends of the hole transport polymer poly-vinylcarbazole (PVK) with electron transport small molecule of 2-(4-Biphynlyl)-5-(4-tert-butylphenyl)-1,3,4-oxadiazole (PBD)[1]. However, concerns about the recrystallization of PBD and other small molecule electron transport materials make it desirable to develop an electron transport polymer (ETP) for use in polymer blends. Previous work in this direction has focused on multi layer devices [2,3] but to our knowledge, no single-layer polymer blend devices using ETP have been made. In this work we describe the preparation and use of an electron transport polymer in such single-layer devices. In this work we focus on polymers with pendant oxadiazole groups similar to PBD. A 2,5-diaryl oxadiazole pendant polymer (POXD) was prepared by the substitution of the chloride groups in poly(vinylbenzyl chloride) (Aldrich; 60/40 mixture of 3- and 4- isomers; Mw ca. ~55,000) with 2-(hydroxyphenyl)-5-phenyl-1,3,4-oxadiazole in basic DMF. $^1H$ NMR spectroscopy of the oxadiazole pendant polymer shows complete substitution of the benzyl chloride groups and we observe no chlorine in the elemental analyses of the polymer. Single-layer devices were successfully fabricated on indium tin oxide (ITO) coated glass using Mg:Ag/Ag electrodes. The single organic layer was deposited via spin coating with the hole transport material PVK, the electron transport material POXD and the emissive dye coumarin 6 (C6) along with PVK/PBD/C6 control devices. Devices had turn-on voltages of ~10-13V, emission spectra matching that of C6 dye (peak = 493 nm), and a quantum efficiency of ~0. 18%. The optimum ratio of hole transport (PVK) to electron transport (POXD) was found to be ~5:2, which is surprisingly similar to the optimal ratio of PVK:PBD in the related molecularly doped devices. Work in progress includes, the continuing optimization of the PVK/POXD/C6 blend devices and examination of new devices with molecular hole transport materials doped into the polymeric electron transport materials. In addition, we will report on the phase segregation in the polymer blend layers utilizing techniques in atomic force microscopy and transmission electron microscopy. This work was supported by NSF and DARPA (1464-967). 1 . C.C. Wu, J.C. Sturm, R. A. Register, J. Tian, E.P. Dana, and M.E. Thompson IEEE, Transactions on Electron Devices 1997, 44, 1269-1280. 2. E. Buchwaid, M. Meier, S. Karg, P. Posch, H. Schmidt, P. Strohriegl, W. Reiß, and M. Schwoerer Adv. Mater. 1995, 7, 839-842. 3. M. Greczmiel, P. Strohriegl, M. Meier, and W. Brutting Macromolecules 1997, 30, 60426046.

**11:20 AM, FF4+**

**Carrier Transport Mechanisms in Organic Electroluminescent Devices**: JUN SHEN[1]; Jie Yang[1]; Ji-Hai Xu[2]; Franky So[2]; H.-C. Lee[2]; [1]Arizona State University, Dept. of Electrical Engineering and Center for Solid State Electronic Research, P.O. Box 875706, Tempe, AZ 85287 USA; [2]Motorola, Inc., Phoenix Applied Research Center, 2100 E. Elliot Rd., Tempe, AZ 85284 USA

We will review the current status of the theoretical understanding of carrier transport mechanisms in organic electroluminescent devices (OEDs). Existing theories are critically compared with available experimental data from various laboratories. The applicability of contact-limited (thermionic emission, Fowler-Nordheim tunneling, etc.) and bulk-limited (trap-charge limited (TCL), field-mobility dependence, etc.) to various conditions is discussed. Then we present our theoretical results on the double-carrier injection devices (OEDs) under trap-charge limited conditions. Our theoretical work consists of two parts: analytical and numerical studies. In our analytical study, we extended previous single-carrier TCL theories to double-carrier case. Several new pieces of physics, which have been puzzling researchers in the field, are revealed and explained using the formula. A new region in the experimental current-voltage characteristics is identified and postulated to be the internal photo de-trapping (IPD) region. Recently, we also developed a numerical model taking into account the main ingredients in the OED TCL transport. Current-voltage characteristics, detailed energy and charge profiles are generated, and some physical insights are gained. For example, we developed clear pictures on the mechanisms that determine the location of the recombination zone, the double v.s. single carrier injection current enhancement, the temperature dependence, etc. Interesting doping effects and contact effects are also studied. In the talk, we will present these results and discuss their relevance with the experimental data.

**11:40 AM, FF5**

**Late News**