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EXAFS Study of the Electroluminescence Materials ZnS:Cu,Cl and ZnS:Cu,Mn,Cl, and EL devices FRANK BRIDGES, M. WARKENTIN, S. A. CARTER, M. ANDERSON, University of California, Santa Cruz — When a high-frequency AC voltage is applied to ZnS:Cu,Cl and ZnS:Cu,Mn,Cl devices, optical fluorescence, known as electroluminescence (EL) is observed which depends on both the Cu and Mn dopants. The local structure of these compounds was studied using the EXAFS technique to understand the role of Cu and Mn. Data were taken at the K-edge of Zn, Cu and Mn, for powder material and for both new and aged (degraded) devices. The EXAFS data show that Mn substitutes for Zn in the ZnS lattice, whereas Cu has a different local structure (it cannot be fit to the ZnS structure). For all the Cu edge data, the first shell of neighbors is best fit using an experimental standard obtained from CuS suggesting that almost all of the Cu resides in tiny CuS-like clusters. Since these clusters are dominant in both the new and degraded samples and do not change with aging, they likely do not contribute directly to the luminescence. Consequently, our results indicate that a very small fraction of the Cu atoms are EL active, possibly isolated defects (substitutional in ZnS) or pairs. Annealing at high T shows that degraded samples can be rejuvenated. Thus, one possible explanation for the rapid degradation of a device is that the isolated Cu ions electro-diffuse to the CuS-like clusters, at which point they no longer produce EL.

Frank Bridges
University of California, Santa Cruz

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