Final Defense

Presented by : Andrew Gallian

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Title:

Optical and Electrical Characteristics of Cr and Fe Doped ZnSe Thin Film and Bulk Materials for Optically and Electrically Pumped Lasers

This work is devoted to evaluating new laser systems based upon chromium and iron doped ZnSe structures. These new systems are based upon new materials, and pumping schemes. These topics can be broken down into three ma jor subgroups: new materials based upon Cr^{2+}:ZnSe, Fe^{2+}:ZnSe lasers and pump sources, and electrically pumped Cr^{2+}:ZnSe systems.

Both hot-pressed ceramic and thin film Cr^{2+}:ZnSe samples were evaluated for their potential as a laser gain medium. This work entailed spectroscopic analysis of both their absorption and emission spectra as well as characterizing the lifetime of luminescence for these materials. For hot-pressed ceramic Cr^{2+}:ZnSe the samples were tested in a laser cavity and proven to be the first laser system in the mid-IR to be demonstrated based upon hot-pressed Cr^{2+}:ZnSe. Thin film Cr^{2+}:ZnSe was determined to have different spectroscopic characteristics for luminescence compared to reference bulk samples. This difference is attributed to location of all of the optical centers within a Fabry-Perot cavity formed by the film surface and the wafer it was deposited on.

Fe^{2+}:ZnSe laser demonstration at room temperature is presented. This laser operates in a spectral region of great interest for spectroscopy. To develop this laser system new pumping systems were required. Such systems as passively Q-switched Er:YSGG and 2nd stokes SRS from a D2 cell. These systems are described in great depth.

Electrically pumped TM^{2+}:II-VI systems are ideal for small portable spectroscopic and scientific tools. The elimination of an optical pump source removes many complications of other systems including complications due to having a second laser. This work was approached by modeling electrically motivated transitions with sub-band optical excitation. Thus lasing of Cr^{2+}:ZnSe was achieved using a 532 nm pump source. This result in combination with photo-current and photo-hall measurements lead to the development of some theories explaining possible electroluminescence. Electroluminescence was also achieved in bulk n-type Cr^{2+}:ZnSe using impacts of hot carriers as an excitation source.

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12:30 p.m. – 2:00 p.m.

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