GAIN AND LASING OF OPTICALLY PUMPED METASTABLE RARE GAS ATOMS

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In recent years there have been concerted efforts to develop high energy diode-pumped alkali vapor lasers (DPAL). These hybrid gas phase / solid state laser systems offer possibilities for constructing high-powered lasers that have high beam quality. DPAL's utilize excitation of the alkali metal $^2P_{3/2} \leftarrow {}^2S_{1/2}$ transition, followed by collisional relaxation and lasing on the $^2P_{1/2} \rightarrow {}^2S_{1/2}$ line. Considerable progress has been made, but there are technical challenges associated with the reactivity of the metal atoms.

Rare gas atoms (Rg) excited to the np^5(n+1)s $^3P_2$ configuration are metastable and have spectral properties that are closely similar to those of the alkali metals. In principle, optically pumped lasers could be constructed using excitation of the np^5(n+1)$p \leftarrow$ np^5(n+1)s transitions. We have recently demonstrated gain and lasing for optically pumped Ar*, Kr* and Xe*. Three-level lasing schemes were used, with He as the collisional energy transfer agent that established the population inversion. These laser systems have the advantage using inert reagents that are gases at room temperature.