THEORETICAL AND SPECTROSCOPIC INVESTIGATIONS OF ALKALI METAL-RARE GAS INTERACTION POTENTIALS

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Alkali vapor lasers pumped by diode lasers are currently being investigated in several laboratories. One problem with this type of device is the poor matching of the relatively broad linewidth of the pump source with the very narrow absorption lines of the atom. Previously, pressure broadening has been used to increase the fraction of the pump laser radiation absorbed. It is also possible that the formation and excitation of alkali metal-rare gas dimers (M-Rg) could be used to achieve the desired spectral broadening. The interactions between $M(^2S)$+Rg pairs are weak, and the potential energy curves exhibit shallow minima that are characteristic of van der Waals bonds. The $M(^2P)$+Rg interactions are much stronger, having characteristics that suggest the formation of incipient chemical bonds. Excitation of the continuum regions of the $M(^2P)Rg \leftarrow M(^2S)Rg$ transitions offers attractive possibilities for utilization of broad band pump radiation in an alkali vapor laser. To explore this possibility we are mapping out the M-Rg potential energy curves using ab initio theoretical methods, in parallel with laser excitation and dispersed fluorescence spectroscopy.