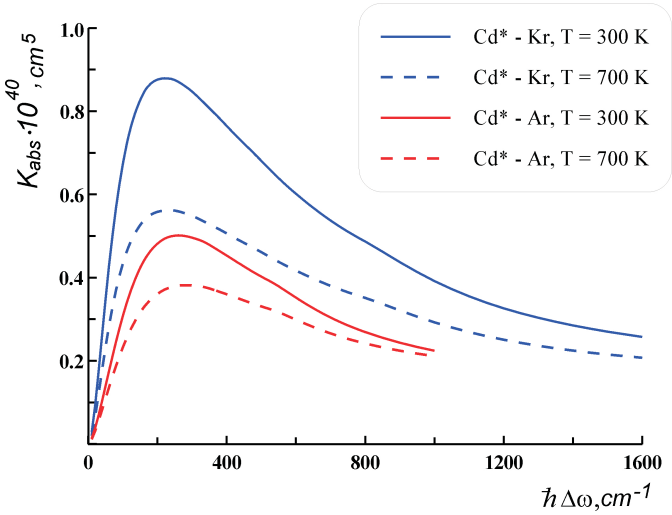
The radiative processes induced by interaction of metastable Cd $\left(5\ ^3P_2\right)$ atoms with Ar and Kr atoms

O.S. Alekseeva[1,2], A. Z. Devdariani[2,3], M. G. Lednev[1], A.L. Zagrebin[1,2]

[1]*Dept. Phys., Baltic State Technical University, St. Petersburg, 190005, Russia*
[2]*Dept. Optics&Spectr., St. Petersburg University, St.Petersburg, 198904, Russia*
[3]*Dept. Theor. Phys., Herzen University, St. Petersburg, 191186, Russia*
snbrn2@yandex.ru

The theoretical study of quasi-molecular absorption and emission near the forbidden atomic line $\mathrm{Cd}\left(5^1\mathrm{S}_0 - 5^3\mathrm{P}_2\right)$ induced by interaction with rare gas atoms $Cd(5s5p\,^3P_2) + RG, CdRG(1(^3P_2) \leftrightarrow Cd(5s^2\,^1S_0) + RG + \hbar\omega, CdRG(X^1\Sigma)$ where $RG = Ar, Kr$ has been performed.

With the use of the semi-empirical method of quasi-miolecular term analysis [1,2] and the available experimental data [3 and references there], the potential curves for the Cd* + Kr and Cd* + Ar systems and the radiative widths were obtained. In the calculation the full semi-empirical procedure was used for the first time. Also the probabilities of the $\nu'\,1\left(^3P_2\right) - \nu''\,0^+\left(^1S_0\right)$ transitions and the radiative lifetimes of the metastable $1\left(^3P_2\right)$ states of Cd-Kr and Cd-Ar quasi-molecules as functions of the vibrational excitation degree were calculated. Based on these semi-empirical results the processes of the collision induced quasi-molecular absorption and emission near the forbidden atomic line $\mathrm{Cd}\left(5^1\mathrm{S}_0 - 5^3\mathrm{P}_2\right)$ in mixtures of Cd vapor with Ar and Kr atoms have been considered, and the absorption coefficients (see Figure), emission spectra and the total rate constants of radiative depopulation of the metastable state of Cd have been determined. The interaction decreases the radiative lifetime $CdRG(1(^3P_2))$ excimers by 5-6 (decimal) orders of magnitude in comparison with $Cd(^3P_2)$.



Experimental studies of the processes under discussion could resolve discrepancies between the present data on energy terms and *ab initio* results [4].

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