DETERMINATION OF THE Be_2(X) POTENTIAL ENERGY CURVE USING STIMULATED EMISSION PUMPING SPECTROSCOPY

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Calculations for the ground state of Be_2 are very sensitive to the level of theory used and the basis sets. Because of this sensitivity, calculations on Be_2 have been used as a test for geminal approaches, coupled cluster methods at various levels of approximation, many-body methods, density functional theory, Monte-Carlo, multi-reference CI and full CI methods. These studies have yielded a wide range of values for the well depth and spectroscopic constants. There has been only one previously reported experimental study of the Be_2(X) binding energy. Bondybey (Chem. Phys. Lett. 109, 436 (1984)) obtained an estimate of D_e=790±30 cm^{-1} from a low resolution dispersed fluorescence spectrum where levels up to ν"=4 could be resolved. In the present work we have used stimulated emission pumping (SEP) to map all of the bound vibrational levels of Be_2(X). Laser excitation and stimulated emission of the $A^1\Pi_u - X^1\Sigma_g^+$ transition of Be_2 has been used in this study. Rotationally resolved SEP spectra have been recorded for ground state vibrational levels ν"=1-10, establishing a dissociation energy of D_e = 927(5) cm^{-1}. Rydberg-Klein-Rees (RKR) inversion of the rotation and vibration data has been used to determine an accurate potential energy curve. Comparisons with the results from recent theoretical calculations will also be presented.