INVERSION VIBRATIONAL ENERGY LEVELS OF AsH_3^+ STUDIED BY ZERO-KINETIC-ENERGY PHOTOELECTRON SPECTROSCOPY

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The rotational-resolved vibrational spectra of AsH_3^+ have been measured for the first time with vibrational energies up to 6000 cm^{-1}above the ground state using zero-kinetic energy photoelectron spectroscopic method. The inversion vibrational energy levels (ν_2) and the corresponding rotational constants for the ν_2 =0-16 have been determined. The tunneling splittings of the inversion vibration energy levels have been observed for the ground and the first excited vibrational states. The geometric parameters of AsH_3^+ as a function of inversion vibrational quantum states have been determined, indicating that the geometric structure of the cation changes from near planar structure to a pyramidal structure with more vibrational excitations. In addition to the experimental measurement, a two-dimensional theoretical calculation including the two symmetric vibrational modes was performed to determine the energy levels of the symmetric inversion and As-H stretching vibrations. The calculated vibrational energy levels are in good agreement with the experimental results. The first adiabatic ionization energy (IE) for AsH_3 was also accurately determined. The result of this work will be compared with our published result on the PH_3^+.