The Ar-HBr cluster has a large amplitude intermolecular bending motion. The excited states of the van der Waals vibrations were observed by infrared and far infrared laser spectroscopy. The cluster has a nearly "linear" structure of Ar-HBr in the ground state ($\Sigma_0^+$ state), while the cluster is estimated to have a nearly "anti-linear" structure of Ar-BrH in the first excited state ($\Sigma_1^+$ state) of the intermolecular bending vibration.

In the present study, we have observed submillimeter-wave transitions of the $\Sigma_1^+ - \Sigma_0^+$ band of Ar-HBr generated in a pulsed supersonic jet expansion. The observed band origins of the $\Sigma_1^+ - \Sigma_0^+$ bands of Ar-H$^{70}$Br and Ar-H$^{81}$Br are 6 and 27 MHz lower than those reported by combination differences of infrared data. The eQq constants in the $\Sigma_1^+$ states were determined for the first time to be 260.90(12) and 217.854(98) MHz for Ar-H$^{70}$Br and Ar-H$^{81}$Br, respectively, which agree well with the estimated values (238 and 199 MHz for Ar-H$^{70}$Br and Ar-H$^{81}$Br) from a potential calculation. The $\cos^{-1}\sqrt{\cos^2\theta}$ value is 144.3º in the $\Sigma_1^+$ state, which is different from the value, 42.1º, in the ground state, where the $\theta$ is an angle between a cluster axis and a HBr monomer axis.

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