VIBRATIONALLY RESOLVED NEGATIVE ION PHOTOELECTRON SPECTROSCOPY OF Nb$_8$

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We have observed a surprisingly simple, vibrationally resolved spectrum for the bare niobium octamer cluster by photoelectron spectroscopy of mass selected Nb$_8^-$ anions. The clusters were prepared in a cw cathode discharge source within a liquid nitrogen cooled flow tube (0.5 Torr), and the spectra were obtained at 488 nm (2.540 eV) with an electron kinetic energy resolution of about 5 meV (40 cm$^{-1}$). The measured electron affinity of 1.513(7) eV is consistent with that obtained in the earlier anion PES study$^a$. In addition, the present spectrum exhibits a single clearly resolved vibrational progression in the transition between the ground electronic states of the anionic and neutral clusters. The frequency of this active mode is 185(15) cm$^{-1}$ in the neutral molecule and 160(20) cm$^{-1}$ in the anion, and the short progression indicates a small normal mode displacement of about 0.5 amu$^{1/2}$Å. These results are discussed in the context of recently reported density functional calculations$^b$ on Nb$_8$ and Nb$_8^-$.