MATRIX ISOLATION ELECTRON SPIN RESONANCE INVESTIGATION OF H_2^+, H_4^+, AND THEIR ISOTOPOMERS

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Hydrogen cluster ions are of interest as reactants in astrophysical processes and as simple models for theoretical calculations. In this work, H_4^+ and its deuterated isotopomers were isolated in a neon matrix and investigated by electron spin resonance spectroscopy. The various isotopomers were formed by mixing H_2, D_2, and HD gases with neon and depositing the mixtures onto a copper rod cooled to 2.6 K. The matrices were then x-irradiated at 60 keV for 30 minutes. Electron spin resonance spectra were recorded for H_4^+, H_3D^+, $H_2D_2^+$, HD_3^+, and D_4^+ at temperatures ranging from 2.6 K to 9 K. These isotopomers could only be formed at 2.6 K, and were very sensitive to changes in temperature. Diatomic hydrogen ions (H_2^+ and HD^+) were also observed at 2.6 K at low sample gas concentrations. Experimental values for the hyperfine interactions were determined by fitting the observed hyperfine structure lines with those obtained from an exact diagonalization of the spin Hamiltonian.