ROTATIONAL SPECTRA OF THE FREE RADICALS C\textsubscript{10}H, C\textsubscript{12}H, C\textsubscript{13}H, AND C\textsubscript{14}H IN A SUPersonic JET


Four new carbon chain radicals C\textsubscript{10}H, C\textsubscript{12}H, C\textsubscript{13}H, and C\textsubscript{14}H have been observed in a pulsed supersonic molecular beam with a Fourier transform microwave spectrometer. The radicals were produced in a discharge through a dilute diacetylene/neon mixture in the throat of a supersonic nozzle. All are found to be linear with $^2\Pi$ electronic ground states, and all except C\textsubscript{14}H have resolved lambda-type doubling. At least 10 rotational transitions, between 6 and 16 GHz, were measured in the lowest spin component $^2\Pi_{9/2}$ of C\textsubscript{10}H, C\textsubscript{12}H, and C\textsubscript{14}H, and the $^2\Pi_{1/2}$ component of C\textsubscript{13}H. Only three spectroscopic constants in the standard Hamiltonian for a molecule in a $^2\Pi$ state were required to reproduce the spectra to a few parts in $10^7$: an effective rotational constant, a centrifugal distortion constant, and a lambda-type doubling constant. Detection of these highly unsaturated carbon chains establishes that C\textsubscript{n}H radicals containing up to 14 carbon atoms are readily produced in a supersonic molecular beam. The relative abundance of C\textsubscript{n}H radicals with an even number of carbon atoms is fairly constant from C\textsubscript{6}H through C\textsubscript{12}H. Although the new radicals are about two orders of magnitude less abundant than C\textsubscript{4}H, the strong predicted $^2\Pi - ^2\Pi$ electronic transitions may be detectable in a supersonic jet by standard laser spectroscopic techniques.