Vibrational spectra of $C_{60}H_x$ with $36 \leq x \leq 60$ and emission/absorption of some interstellar clouds

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Hydrogenated fullerenes $C_{60}H_x$ with x in the range 36 to 60 and $C_{60}D_{60}$ were synthesized at a hydrogen or deuterium pressure of 50±5 kbar and temperatures up to 500°C. Hydrogen or deuterium contents were estimated by combustion of fulleranes in the oxygen flow and weighting of the resultant products, CO_2 and H_2O. IR transmission spectra of thin crystalline specimens or powders were measured at room temperature in the spectral range of 600÷5000 cm^{-1} using the IR microscope of the Fourier-spectrometer.

The well-known increase of a number of the dipole-active vibrational modes was observed when we got over from highly-symmetrical C_{60} to fulleranes $C_{60}H_x$ with x=36, 42, 48, which was a result of the lowered molecular symmetry. The number of the dipole-active vibrational modes decreased again in $C_{60}H_{60}$ and $C_{60}D_{60}$. This indicated their higher symmetry in comparison with $C_{60}H_x$, x=36÷ 48. However, our spectra showed that the symmetry of the $C_{60}H_{60}$ and $C_{60}D_{60}$ molecules was not that of a truncated icosahedron as in the usual model for C_{60}, but rather an orthorhombic one.

We found that a combination of the vibrational modes of $C_{60}H_{60}$ and, for example, $C_{60}H_{48}$ may explain the emission and absorption spectra of some interstellar and sircumstellar clouds. This experimental result conforms with the theoretical proposal of Adrian Webster [1] on the nature of the unidentified astronomical infrared emission features.

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[1] A. Webster, *Nature* **352** 412-414 (1991); *Mon. Not. R. Astron. Soc.* **264**, 121-131 (1993).