Fragmentation and Ionization of Laser Desorbed La@C₈₂

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Highly excited La@C₈₂ has been investigated using laser desorption mass spectrometry. A pulsed 337 nm N₂ laser was used to desorb the fullerene material from thin films. The detected mass spectra (see figure 1) were dominated by the La@C₈₂-2m⁺ where m = 0 - 12. The metallofullerene is fragmenting into smaller metal containing fullerenes, but empty fullerenes are detected as well as small fragments (see inset of figure). We also measure a tail after the main La@C₈₂⁺ peak which is due to delayed ionization. This is the first report of delayed ionization of a metallofullerene as far as we know and we suggest that metal containing fullerenes can be used as model systems for investigations into the delayed ionization of empty fullerenes. As the metals are thought to donate several electrons to the fullerene orbitals (see e.g. [1]) the electronic structure of metallofullerenes should be different from that of empty fullerenes.

Figure 1. A La@C₈₂ mass spectrum showing the fragmentation by C₂ loss and loss of LaC₆. The tail after the main La@C₈₂⁺ peak is due to delayed ionization of the metallofullerene.

The highly excited metallofullerene is fragmenting as an ordinary fullerene by C₂ loss and ionization, but has extra fragmentation channels with the loss of the internal La ion and LaCₙ⁺ (n = 2, 4) fragments. In comparision with mass spectra on C₆₀ at similar laser conditions the La@C₈₂ mass spectra show more fragments created by loss of C₂ units. As the dissociation energy has been measured to be almost the same for the two fullerenes [2] we propose that the metallofullerene is fragmenting predominantly in the ionic channel.

References:
