$C_{60}F_{18}$: THE Most Versatile Fullerene

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As a learning tool, $C_{60}F_{18}$ is pre-eminent because it has properties and undergoes a range of reactions possessed by no other fullerene or derivative. It demonstrates how the fullerene shape can be transformed by addition, and that addition can greatly increase fullerene aromaticity and polarity. It can co-ordinate uniquely to transition metals, behave as an electrophile for aromatic substitution, undergo both C-C and C-F bond insertion, and participate in normal nucleophilic substitution. It provided the first proof of the S_N2' mechanism of nucleophilic substitution in a fullerene, leading to a new class of derivatives, the fullerene 18π annulenes, with yet further shape modifications and possible photoelectric applications. It can undergo [4 + 2], [3 + 2], [1 + 2], and [2 + 2] cycloadditions, the latter coupled with unique fluorine elimination. These properties have been demonstrated by a combination of HPLC, mass spectrometry, ^{1}H NMR, ^{19}F NMR, and single crystal X-ray studies using <5 mg per study, showing what can be achieved with modern instrumentation. This work provides also an example of how perseverance with failure leads ultimately to success, and how one can be mislead into valid but erroneous interpretation of data.