Fullerene Superconductivity 20 Years on

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A_3C_{60} (A=alkali metal) superconductors were known to adopt fcc structures with their superconducting T_c increasing monotonically with increasing interfullerene spacing, reaching a 33 K maximum for $RbCs_2C_{60}$; this physical picture had remained unaltered since 1992. Trace superconductivity (<0.1%) at 40 K under pressure was also reported in 1995 in multiphase samples with nominal composition Cs_3C_{60}. Despite numerous attempts by many groups worldwide, this remained unconfirmed and the structure and composition of the material responsible for superconductivity unidentified. Thus the possibility of enhancing fulleride superconductivity and understanding the structures and properties of these archetypal molecular solids had remained elusive. Here I will present our recent progress in accessing high-symmetry hyperexpanded alkali fullerides in the vicinity of the Mott-Hubbard metal-insulator boundary and at previously inaccessible intermolecular separations. The physical picture that emerges for the alkali fullerides is that, contrary to long-held beliefs, they are the simplest members of the high-T_c superconductivity family. We demonstrated this by showing that in the two hyperexpanded Cs_3C_{60} polymorphs (fcc- and A15-structured), [1] superconductivity emerges upon applied pressure out of an antiferromagnetic insulating state and displays an unconventional behaviour, a superconductivity dome, explicable by the prominent role of strong electron correlations.

[1] Y. Takabayashi et al., Science **323**, 1585 (2009); A. Y. Ganin et al., Nature **466**, 221 (2010).

INVITED PAPER