Strongly Correlated Molecular Superconductors

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The structural and electronic properties of C_{60}-based solids have been exhaustively explored for more than 20 years. They were long recognized as archetypal examples of molecular superconductors with the highest superconducting transition temperatures (T_c) among all molecular systems known. Their structural and electronic phenomenology and the dominance of strong electron correlations in defining their behavior have posed significant challenges for our understanding of high-temperature superconductivity in these highly correlated organic metals. Here I will briefly review the structures and properties of intercalated fullerides, paying particular attention to the metal–antiferromagnetic-insulator transition at large interfullerene separations.

An apparent exciting development in molecular superconductivity research occurred recently with the reports that alkali metal intercalation of polyaromatic hydrocarbons can lead to the isolation of superconducting materials of unknown composition and structure with T_cs as high as 33K. However, despite the flare of experimental and theoretical activity in this field, it has not proven possible as yet for the experimental results to be reproduced, while the identities of the putative superconducting phases, including their composition and structure still remain unknown. Therefore, devising new synthetic routes beyond the standard solid state methodology to afford isolation and structural and electronic characterization of *highly-crystalline phase-pure materials in a reproducible fashion* is of paramount importance. Here I will report the first results in our exploration of the alkali-phenanthrene phase field –phenanthrene, $C_{14}H_{10}$ is the smallest phenacene for which superconductivity was reported at 5K for its K- and Rb-intercalated salts– that include the first unambiguous structural and electronic characterization of alkali phenanthride salts.