Road to Higher T_c Superconductivity

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Abstract — The highest superconducting transition temperature T_c remains 135 K (164 K at pressure of 30 GPa) which was recorded in 1993 (1994) for Hg-based trilayer cuprate. The "silence" period over 20 years is the longest in the history of superconductivity started from 1911. In contrast to the long silence in T_c, several material families have successively been found to show superconductivity at temperature higher than the old record 23 K. These include MgB_2 and iron arsenides/selenides, indicating that there are several routes toward higher T_c. In fact, three different classes of high-T_c materials have recently shown a signature of higher T_c superconductivity under extreme conditions that may break the long silence.

So far the highest T_c is 55 K for bulk iron arsenides which was achieved in 2008, but T_c stopped rising since then. However, monolayer FeSe film deposited on a $SrTiO_3$ substrate appears to show superconductivity at T = 60 K or higher [1].

MgB_2 with T_c = 39 K is obviously a conventional superconductor in which phonon-mediated superconductivity is optimized. A recent report that H_2S under extremely high pressures, over 150 GPa shows a superconducting signal at 190 - 203 K [2, 3], if it is real, may be understood as a case of further optimization of the circumstances in MgB_2 by substitution of B with much lighter H.

Even in the case of the cuprates, it has recently been reported that the interlayer Josephson plasma mode, characteristic of the cuprate superconductivity, is transiently (for a few picoseconds) induced above 300 K by pumping c-axis polarized THz light pulses for underdoped YBCO [4].

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Keywords (Index Terms) — Cuprates, MgB_2, iron arsenides/selenides, H_2S under high pressures.