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Superconductivity in boron-doped carbon-nanotubes

J.Haruyama[1], S.Maruyama[2], N.Shinohara[3], S.Saito[4] and A.Rao[5]

[1] *Aoyama Gakuin University ; Institute for Solid State Physics, Tokyo University ;JST-CREST*

[2] *The Tokyo University*

[3] *Nagoya University ; JST-CREST*

[4] *Tokyo Institute of Technology*

[5] *Clemson University*

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Superconductivity (SC) in carbon nanotubes (CNTs) is attracting considerable attention from viewpoints of (1) physics of one-dimensional (1D) SC, (2) electron correlation in 1D conductors, (3) carbon-based new-superconductor family(CaC_6 and boron-doped diamond), and (4) realization of high-Tc SC. Previously, we reported on SC in the arrays of multi-walled CNTs (MWNTs) with the world-highest Tc = 12K and its correlation with 1D electron correlation [1]. After then, based on the report, many theories for the CNT-SC have been proposed ; e.g., 1.Carrier doping effect in MWNTs and 1D electron correlation and 2.Carrier doping effect in (10,0) single-walled CNTs (SWNTs).

Here, we have had significant progress in the experiments after reporting Ref.[1] e.g., (1) confirmation of Meissner effect with Tc = 20K [2], (2) Observation of interplay of SC and 1D electron correlation (Tomonaga-Luttinger liquid states) [3-1], (3) Confirmation of presence of boron (B) in the MWNTs by NMR [3-1]. In particular, the third issue for B-doping was very important finding.

In the talk, I will focus on finding of SC in B-doped CNTs. I show the following two cases ; (1) SC in arrays of B-doped MWNTs [3-1] and (2) SC in highly-homogeneous thin films consisting of B-doped SWNTs [3-2]. In both cases, boron are doped in very small concentration ($<$ a few at.SC in B-doped CNTs is promising and will shed light to study of novel type 1D SC. It could lead to higher Tc up to 40K by further optimization of doping condition.

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[3] 1 :J.Haruyama, J.Gonzalez et al., ; 2 :J.Haruyama, A.M.Rao, S.Saito et al. Both are submitted to Phys.Rev.Lett.