## PCP3-2

### Exploration of New Superconducting Phases in a Scandium Borocarbide System

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Superconducting materials containing light elements are advantageous to emerge the relatively high critical temperature ($T_c$), because high-frequency vibration of phonons due to the light mass enhances its $T_c$ within the BCS theory. Indeed, there are various superconductors in alkali, alkali-earth, and *d* transition-metal borides and carbides [1-3].

In this study, we searched for a new superconductor in the ternary Sc–B–C system using an arc-melting method. Although a moderately high-$T_c$ superconductor is expected in combination with the comparatively small ionic radius of Sc and potentially high Debye frequencies originating from B and C, this system remains unexplored.

We attempted to synthesize the Sc–B–C compounds under various conditions of the starting composition, and found that a superconducting transition was observed at around 7.7 K only when the B-poor sample (e.g. nominal composition of Sc:B:C=37:2:61) was prepared [4]. Note that neither B-free nor B-excess samples exhibited the superconductivity down to 2 K. The structural refinements through the Rietveld analysis demonstrated that the compound belongs to the tetragonal space group of *P*4/*ncc*. By using the density functional theory calculations, the precise atomic positions of a small amount of B were examined. As a result, a chemical formula of the present superconducting phase was found to be expressed as $Sc_{20}C_{8-x}B_xC_{20}$($x$=1 or 2).

The sample exhibited the typical type-II superconductivity below $T_c$=7.7 K. Our specific-heat measurements revealed that $Sc_{20}C_{8-x}B_xC_{20}$ was classified as an intermediately coupled superconductor. The electronic structure studies by first principles calculations proposed that the contribution of Sc-3*d* orbitals was mainly responsible for the superconductivity.

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