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M2Po2A-02 [26]: Superconducting Fibers of Fullerene-based Materials

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Superconductivity of alkali-metal(A)-doped fullerenes was found in 1991. A-doped fullerides AxC60 [0<x<6] are particularly interesting since their structures and electronic properties are strongly related to the doping carrier concentration. The compound, A3C60, shows superconducting transition at 19K (A=K), 29K (A=Rb) or 33K (A=Cs2Rb). Various types of fullerene-based supramolecular materials have been developed by Miyazawa et al. using a liquid-liquid-interfacial-precipitation (LLIP) technique, so far, such as nanowhiskers (C60NWs), nanosheets, nanowires, and nanotubes. If such a form of C60NWs turns out to be a superconductor, it will be a promising material for superconductive fibers or wires. We have tried to dope alkali metals (K, Rb, Cs2Rb) into the C60NWs for future application to superconducting light fibers. First, superconductivity was observed at 17 K in the K-doped C60NWs heated at 200oC and their superconducting volume fraction reached 80 % in 24 hours. In contrast, K-doped C60 raw material powders showed only 1 % fraction. Such a low superconducting volume fraction in K3C60 superconductors has been reported in previous papers. We believe this difference is caused from nanopores in C60NWs by the LLIP, which assist K-migration in the materials. We report the superconducting properties of our newly synthesized AC60NWs (A=Rb3, Cs2Rb) in comparison to K3C60NWs. The critical current density (Jc) of AxC60NW is estimated over 105A/cm2 up to 5 T using the Bean model in M-H curves. It shows a high Jc in K3.3C60NWs compared to the others. The upper critical field and other superconducting properties will also be reported and discussed. This work is supported by JSPS-KAKENHI program#18K04717.

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