Volution of upper critical field in fullerene superconductors near the Mott transition

YUICHI KASAHARA, YOSHIHIRO IWASA, Quantum-Phase Electronics Center, The University of Tokyo, MATTHEW ROSSEINSKY, University of Liverpool, RUTH ZADIK, KOSMAS PRASSIDES, Durham University — We here report systematic investigations of the upper critical field $H_{c2}$ of alkali-metal-doped fullerene superconductors $A_3C_{60}$ ($A$: Alkali metal) including $\text{Rb}_x\text{Cs}_{3-x}C_{60}$ ($0 < x < 1$), which is a new series of expanded fullerene superconductors. Using $\text{Rb}_x\text{Cs}_{3-x}C_{60}$, we can access the novel regime from the $T_c$ maximum to the antiferromagnetic phase even at ambient pressure. We have successfully synthesized high-purity $\text{Rb}_x\text{Cs}_{3-x}C_{60}$ compounds with several Rb compositions of $x$. Determination of $H_{c2}$ has been demonstrated by rf-penetration depth measurements under pulsed magnetic field up to 62 T. With expanding lattice volume with decreasing $x$, the system approaches to the Mott insulator from the superconducting phase. We found that $H_{c2}$ continuously increases with decreasing $x$ and it reaches as large as 80 T in the lowest $x = 0.35$, which is almost the verge of the Mott transition. Combining with specific heat measurements, underlying phenomena in the superconductor-insulator transition in the fullerene compounds will be discussed.

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