Nano-Sized effects on the physical properties of la-based high-Tc superconductors and its parent compound (La2-xSrxCuO4 and La2CuO4 = Efek nano-sized terhadap sifat magnetik la-based high-Tc superkonduktor dan material induknya (La2-xSrxCuO4 dan La2CuO4)

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Abstrak

The change of the electric and magnetic properties due to the particle size effect has been reported recently and opened a new door to investigate phenomena driven by dimensional effects. One of the interesting examples is nanogold which is a weak diamagnetic in a bulk state but it becomes ferrimagnetic when the size of the Au cluster is around 3 nm. In the case of the Mott insulating system, it is reported that the magnetic transition temperature, TN, drastically decreased due to nano-sized effects. The reason for the appearance of the ferrimagnetic phase and the reduction in TN are not fully understood and still an open question. We investigated nano-sized effects in typical Mott insulator, La2CuO4, and in high-Tc superconductor cuprates, La2-xSrxCuO4. From muon spin relaxation (SR) measurements, it is observed that the TN drastically decreased to be 47(12) K with reducing the particle size of La2CuO4 down to 24 nm. The phase separation of long-range and short-range magnetic ordering state was observed. We proposed a core-shell model to describe it. Particle size affects the magnetic interaction in La2CuO4 where the inter-plane magnetic interaction, J', plays an important role in controlling TN of antiferromagnets. In the case of La1.80Sr0.20CuO4, we found that there is a strong suppression of the superconducting state and the appearance of weak magnetism induced by nano-sized effects. These results revealed that magnetic orders and superconductivity are intertwined and interconnected in high-Tc cuprate superconductors.
.....Perubahan sifat listrik dan magnet yang disebabkan efek ukuran partikel telah diteliti secara intensif akhir-akhir ini dan membuka pandangan baru dalam investigasi fenomena yang di-drive oleh efek dimensi. Salah satu contoh efek partikel yang sangat menarik adalah nano-gold. Gold (Au) bersifat dimagnetik lemah dalam keadaan bulk tetapi menjadi ferrimagnetik saat ukuran cluster Au dikecilkan menjadi 3 nm. Di kasus sistem Mott insulating, suhu transisi magnetik, TN, dilaporkan menurun karena nano-sized effects. Alasan munculnya fasa ferrimagnetik dan menurunnya TN di sistem nano masih belum dipahami sepenuhnya dan masih menjadi pertanyaan. Kami menginvestigasi nano-sized effects di typical Mott insulator, La2CuO4, dan high-Tc superconductor cuprates, La2-xSrxCuO4. Dari hasil pengukuran muon spin relaxation (SR), dihasilkan bahwa TN menurun drastis menjadi 47(12) K dengan dikecilkannya ukuran partikel menjadi 24 nm. Dari hasil SR, teramati juga adanya pemisahan fasa antara long-range dan short-range magnetic ordering. Core-shell model diajukan untuk menjelaskan pemisahan fasa magnetic ordering yang terjadi di La2CuO4 nanopartikel. Kami menemukan bahwa inter-plane magnetic interaction, J', berperan penting dalam mengontrol perubahan TN di antiferromagnet. Pada kasus La1.80Sr0.20CuO4, teramati adanya penurunan superconducting state secara drastis dan munculnya weak magnetism yang disebabkan oleh nano-sized effects. Hasil ini menunjukkan bahwa magnetic orders dan superkonduktivitas saling terkait dan berhubungan.