

Nano-Sized effects on the physical properties of la-based high-Tc superconductors and its parent compound ( $\text{La}_{2-x}\text{Sr}_x\text{CuO}_4$  and  $\text{La}_2\text{CuO}_4$ ) = Efek nano-sized terhadap sifat magnetik la-based high-Tc superkonduktor dan material induknya ( $\text{La}_{2-x}\text{Sr}_x\text{CuO}_4$  dan  $\text{La}_2\text{CuO}_4$ )

Suci Winarsih, author

Deskripsi Lengkap: <https://lib.ui.ac.id/detail?id=20516162&lokasi=lokal>

---

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,  $T_N$ , drastically decreased due to nano-sized effects. The reason for the appearance of the ferrimagnetic phase and the reduction in  $T_N$  are not fully understood and still an open question. We investigated nano-sized effects in typical Mott insulator,  $\text{La}_2\text{CuO}_4$ , and in high-Tc superconductor cuprates,  $\text{La}_{2-x}\text{Sr}_x\text{CuO}_4$ . From muon spin relaxation (SR) measurements, it is observed that the  $T_N$  drastically decreased to be 47(12) K with reducing the particle size of  $\text{La}_2\text{CuO}_4$  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  $\text{La}_2\text{CuO}_4$  where the inter-plane magnetic interaction,  $J'$ , plays an important role in controlling  $T_N$  of antiferromagnets. In the case of  $\text{La}_{1.80}\text{Sr}_{0.20}\text{CuO}_4$ , 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,  $T_N$ , dilaporkan menurun karena nano-sized effects. Alasan munculnya fasa ferrimagnetik dan menurunnya  $T_N$  di sistem nano masih belum dipahami sepenuhnya dan masih menjadi pertanyaan. Kami menginvestigasi nano-sized effects di typical Mott insulator,  $\text{La}_2\text{CuO}_4$ , dan high-Tc superconductor cuprates,  $\text{La}_{2-x}\text{Sr}_x\text{CuO}_4$ . Dari hasil pengukuran muon spin relaxation (SR), dihasilkan bahwa  $T_N$  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  $\text{La}_2\text{CuO}_4$  nanopartikel. Kami menemukan bahwa inter-plane magnetic interaction,  $J'$ , berperan penting dalam mengontrol perubahan  $T_N$  di antiferromagnet. Pada kasus  $\text{La}_{1.80}\text{Sr}_{0.20}\text{CuO}_4$ , 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.