



## Antiferromagnetism in YBa<sub>2</sub>Cu<sub>3</sub>O<sub>6+x</sub> nanoparticles studied by elastic neutron scattering (poster)

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*Published in:*

Superconductivity and magnetism: Materials properties and developments. Extended abstracts

*Publication date:*

2003

*Document Version*

Publisher's PDF, also known as Version of record

[Link back to DTU Orbit](#)

*Citation (APA):*

Kuhn, L. T., Andersen, P., Lefmann, K., Andersen, N. H., Nielsen, M. M., Paturi, P., & Raittila, J. (2003). Antiferromagnetism in YBa<sub>2</sub>Cu<sub>3</sub>O<sub>6+x</sub> nanoparticles studied by elastic neutron scattering (poster). In N. H. Andersen, N. Bay, J-C. Grivel, P. Hedegård, D. McMorro, S. Mørup, L. T. Kuhn, A. Larsen, B. Lebeck, K. Lefmann, P-E. Lindelof, S. Linderoth, ... N. F. Pedersen (Eds.), *Superconductivity and magnetism: Materials properties and developments. Extended abstracts* Roskilde: Risø National Laboratory.

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## ANTIFERROMAGNETISM IN $\text{YBa}_2\text{Cu}_3\text{O}_{6+x}$ NANOPARTICLES STUDIED BY ELASTIC NEUTRON SCATTERING

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The interplay between antiferromagnetism and superconductivity in the compound  $\text{YBa}_2\text{Cu}_3\text{O}_{6+x}$  in bulk form has been intensively studied; see for instance.<sup>1</sup> We have initiated a similar study but now focusing on the properties as the size of  $\text{YBa}_2\text{Cu}_3\text{O}_{6+x}$  nanoparticles becomes comparable to the coherence length for superconductivity. Here we present the first results on the antiferromagnetic phase of  $\text{YBa}_2\text{Cu}_3\text{O}_{6+x}$  ( $x = 0.15$ ,  $x = 0.25$  and  $x = 0.37$ ) nanoparticles, i.e. the behaviour of the Néel temperature for the various degrees of oxygen doping, studied by elastic neutron scattering.

The YBCO nanoparticles were prepared by a citrate gel modification of the sol-gel technique as described in<sup>2</sup>, and subsequently reduced in a  $\text{N}_2$  atmosphere to zero oxygen doping. The YBCO nanoparticle powder were in a controlled manner oxidized in an  $\text{O}_2$  atmosphere obtaining different degrees of oxygen doping, i.e.  $x = 0.15$ ,  $x = 0.25$  and  $x = 0.37$ . The composition, crystal structure and the nanoparticle size and shape was characterized by x-ray powder diffraction and high resolution electron microscopy showing that the main part of the nanoparticles are pure tetragonal phase  $\text{YBa}_2\text{Cu}_3\text{O}_{6+x}$ , however a few percent of the impurity phase  $\text{Y}_2\text{Cu}_2\text{O}_5$  is present. The YBCO nanoparticles are disk-shaped with the Cu-O planes perpendicular to the short axis of the disk and have an average diameter of 50 nm.

The elastic neutron scattering was performed at the triple-axis spectrometer RITA-2 at SINQ, Paul Scherrer Institute, Switzerland. The spectrometer was run at 5meV, and the beam was defined by slits at the monochromator, at the sample and at the analyser. A Be-filter with radial collimators was inserted between sample and analyser to reduce higher order scattering. Elastic  $q$ -scans were measured on the samples in the temperature range 15 K to 500 K. In the  $q$ -range we have studied there are two antiferromagnetic reflections, i.e.  $(\frac{1}{2} \frac{1}{2} 1)$  and  $(\frac{1}{2} \frac{1}{2} 2)$ , but due to the very low intensity we have focussed our study on the  $(\frac{1}{2} \frac{1}{2} 1)$  reflection. We have measured the behaviour of this reflection with temperature for  $x = 0.15$ ,  $x = 0.25$  and  $x = 0.37$  and hereby measured the transition between the paramagnetic and antiferromagnetic phase and obtained the Néel temperature, which decreases with increasing  $x$ -value. For this nanoparticle size the Néel temperatures correspond to the bulk values.

### REFERENCES

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