Friday, September 1, 2006

Session Title:	***SQUID Applications - II***
Session Chairs:	***Saburo Tanaka, Toyohashi Univ. of Tech. & Joern Beyer, PTB Berlin***
Paper Number:	***5EF04***
Start Time:	***2:00pm***
Session Type:	***Poster***

Eddy Current-based SQUID-NDE for Detection of Surface Flaws on Copper Tubes

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Copper tubes have been employed in mainly air conditionings as heat-exchanger tubes. During the making process of the tubes, small flaws have accidentally occurred on the tube surfaces. They are lengthened and thinned with the tubes, finally become shallow and long flaws. Recently, surface flaws less than several tens micrometer in depth on the tubes of less than 1 mm in thickness are the serious problem that causes tube breakage in post-processes. Nowadays, it is difficult by commercial eddy current testing system to detect such shallow flaws. We have developed an eddy current-based SQUID-NDE system for detection of the surface flaws on the copper tubes employing an HTS-SQUID gradiometer and Helmholtz coil-type inducer. Copper tubes of 6.35 mm in outer diameter and 0.8 mm in thickness with a variety of flaw shapes, which ranged 10 – 100 micrometer in depth, 50 – 200 micrometer in width, and 2 – 25 mm in length, were prepared as specimens. With an excitation field of 5.6 micro-T at 3 kHz by means of the inducer, magnetic signal due to the flaws were measured by the SQUID-NDE system while moving the specimens through the inducer at 10 mm/s. As a typical result, a magnetic signal due to a 10-micrometer-depth flaw of 100 micrometer in width and 15 mm in length was clearly measured. The signal amplitude was proportional to the flaw depth, width, and length. It suggests that the signal amplitude should be proportional to the flaw volume, which is the product of flaw depth, width, and length. It also suggests that the amount of eddy current, which was forced to detour around the flaw, should determine the magnetic signal.
