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STUDY ON NONDESTRUCTIVE INSPECTION USING HTS-SQUID FOR FRICTION STIR WELDING BETWEEN DISSIMILAR METALS

Y. Hatsukade, T. Takahashi, T. Yasui, M. Tsubaki, M. Fukumoto, S. Tanaka
(Toyohashi University of Technology)

Friction stir welding (FSW) is a novel technique of welding between dissimilar metals such as aluminum and steel. So far, the quality control for FSW is mainly carried out with destructive testing. Nondestructive inspection (NDI) using ultrasonic is partially on trials, but the reliability has not been well clarified. HTS-SQUID is an extremely sensitive magnetic sensor that suits to NDI on metals well. By measuring dBz/dy and dBz/dx using planar SQUID gradiometer, a method to measure distribution of current density J_x and J_y flowing in a subject has been studied. Since current distribution in the subject is determined by electric conductivity, the distribution of conductivity can be estimated from the current distribution. If there are any relation between mechanical strength and conductivity of FSW, SQUID-NDI may have a potential to evaluate strength characteristic of FSW. Here, we investigated a capability of SQUID-NDI for FSW between dissimilar metals, aluminum (A6063) and stainless steel (SUS304), which were welded under different conditions. By applying our SQUID-NDI method to the FSW between Al and SUS, we found that a FSW, which was made with rotation speed and moving speed of the tool 4000 rpm and 500 mm/min, had enough high conductivity that allowed current to flow through FSW. In contrast, a FSW, which was made with moving speed 200 mm/min and the same rotation speed, conductivity of FSW was so low that current injected in the FSW specimen could not pass through the FSW. These results qualitatively agreed with results by destructive testing.