1.2.8. DEVELOPMENTS IN NDT OF FRICTION STIR WELDING USING EDDY CURRENTS

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New demands for NDT techniques are incoming associated with the increase of industrial applications of welding by friction stir (FSW), one of the most remarkable development in the recent history of production technologies. One type of imperfections not possible to address with actual NDT solutions available in the market is the micro defects at the root of less than 100 micron (fig. 1). The morphology and location of these defects may lead to relevant losses of mechanical resistance of the joints, particular under fatigue loading. Moreover, actual NDT reliability in characterizing and sizing these defects still remains a challenge. This paper reports the development of an innovative eddy current (EC) probe, and its application to FSW. The new EC probe (fig. 2) presents innovative concept issues, allowing 3D induced current in the material (fig. 3), a lift-off independence, and an easy interpretation of the signal based on a comprehensible qualitative change.

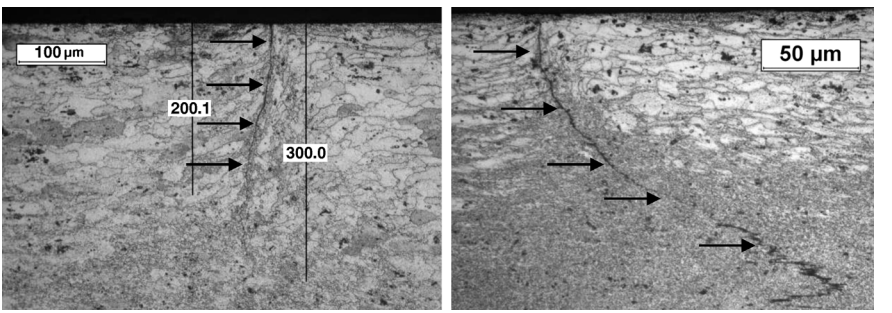

Fig. 1. Transversal weld bead macrograph with typical root defects on butt joint

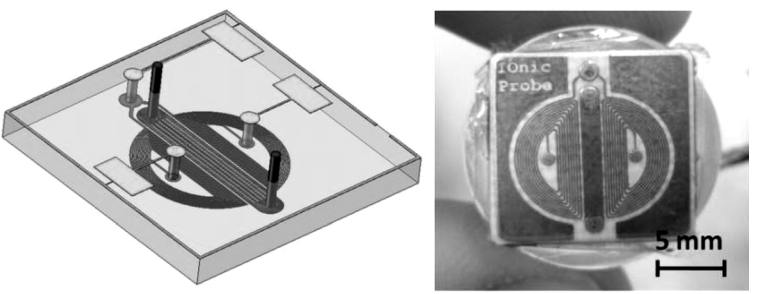

Fig. 2. The IOnic Probe prototype

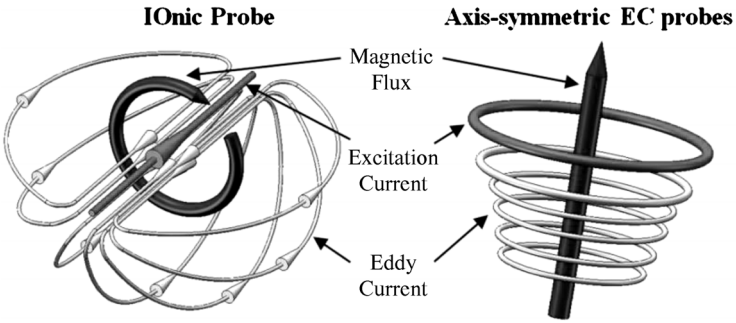

Fig. 3. Eddy currents display in IOnic Probe (left) and conventional axis-symmetric EC probes (right)

A relation between the defects size and some signal features was achieved, by using a dedicated algorithm computationally implemented. Analytical and numerical simulation tools were also developed. The theoretical results fully agree with experiments and it helps on probe optimization and signal understanding.

The new EC probe was applied on standard defects, aluminium alloys processed by FSW, and on Fiber Metal Laminate Composites. All results were compared with conventional helicoidally and planar spiral EC probes. The results allow concluding that the new EC probe is able to detect and sizing micro root defects on FSW with less than 60 micros depth. The probe can also detect deeper defects on Fiber Metal Laminate Composites comparing to conventional EC probes.