Laser cleaning and welding of aluminium alloys for automotive manufacture

Lin Li[1] A.W. AlShaer[1] and A.Mistry[2]
[1]Laser Processing Research Centre, School of Mechanical, Aerospace and Civil Engineering, The University of Manchester, Oxford Road, Manchester M13 9PL, UK
Email: lin.li@manchester.ac.uk
[2]Advanced Manufacturing Engineering, Jaguar and Land Rover, Banbury Road, Badon, Warwick, CV35 0RR, UK

Abstract

Laser welding of aluminium alloys typically results in porosity in the fusion zones leading to poor mechanical and corrosion performances. Porosity can be formed from a number of reasons including surface contamination, H_2 trapping and keyhole instability. This work investigates various factors affecting porosity formation and the the effects of short pulsed laser surface cleaning on the porosity formation in laser welding of AC-170PX (AA6014) aluminium sheets (coated with titanium and zirconium and lubricated using a dry lubricant AlO70) using several filler wires including AlSi5 (AA4043). Porosity, weld fusion zone geometry were examined before and after laser cleaning. Nanosecond pulsed Nd:YAG laser cleaning at 1.06 μm wavelength was found to reduce porosity significantly in the weld fusion zones. For fillet edge welds, porosity was reduced to less than 0.5% compared with 10-85% without laser cleaning. This has been found due to the elimination of contaminations and oxide layers that contribute to the porosity formation. The laser cleaning is based on thermal ablation. The work was carried out in collaboration with an automobile manufacturer and the technology has now been applied for lightweight transportation vehicle production.

Biography

Professor Lin Li,*Fellow of Royal Academy of Engineering (FREng, UK')*, UK,holds a chair of laser engineering, Director of Laser Processing Research Centre at The University of Manchester UK. He has over 550 publications in peer reviewed journals and conference proceedings and 47 patents related to laser processing photonic engineering. He serves on the editorial boards of 12 international journals and is the President-elect of Laser Institute of America, and Vice President of Association of Laser Users (AILU). Professor Li received ***Sir Frank Whittle Medal*** from the Royal Academy of Engineering, UK in 2013 for his outstanding achievements in engineering innovations in manufacturing that has led to wide commercial applications. In 2014 he received ***Wolfson Research Merit Award*** from the Royal Society for his research on laser nano-fabrication and nano-imaging. He received ***Researcher of the Year Medal*** from The University of Manchester, UK, in 2014.