Microstructure, mechanical, and failure characteristics of laser-microwelded AZ31B Mg alloy optimized by response surface methodology

M. N. M. Salleh & M. Ishak & M. M. Quazi & M. H. Aiman
Faculty of Mechanical Engineering, Universiti Malaysia Pahang, 26600 Pekan, Pahang, Malaysia

ABSTRACT

Thin sheets of magnesium alloys are finding promising applications in automotive, biomedical, and electronics industries, where joining of components requires fusion microwelding. In the present research, laser microbeam welding (LBW) of 0.6-mm-thick AZ31B Mg alloy was investigated based on response surface methodology to optimize tensile-shear strength. The effect of pulse energy (EP), welding speed (WS), and angle of irradiation (AOI) on geometrical and mechanical properties of the welds was studied. Shear-tensile tests of the samples under optimized welding parameters produced defect free joint with the highest strength of 80.5MPa corresponding to a fracture load of 800 N. Finer grains that were 12 times smaller than the as-received alloy were witnessed in the fusion zone with an average grain size of 1.5 μm. The enhancement in hardness of 77 HV was attributed to the microstructural refinement in the fusion zone consisting of elongated grain structure in the presence of α-Mg precipitates. Failure characteristics of joints revealed evaporative loss of alloying elements that resulted in the transgranular brittle fracture in the heat-affected zone..

Keywords: Laser welding; Magnesium ; Biomaterials; Mechanical properties; Fractography; Defects