Experimental Study on Thermal Contact Resistance and Contact Pressure of Aluminum Blocks and Aluminum Honeycombs

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ABSTRACT

This thesis is divided into two parts: the first part is "Research on Thermal Contact Resistance and Interfacial Pressure of Aluminum Blocks", and the second part is "Research on Thermal Contact Resistance and Interfacial Pressure of Aluminum Honeycombs". The first part of this thesis was an experimental study of thermal contact resistance conducted with metallic contacts across bolted joints. Three types of interfaces were considered, including Al/Al, Cu/Al, and SS/Al contacts. The aluminum sample has a square cross section (63.5 mm × 63.5 mm) and a height of 50 mm. The bolt patterns included 4 and 8 bolt configurations. The bolt shaft diameter was 8 mm. The contact pressure of bolted interfaces was measured by the pressure-measuring film through an image processing technique. Results indicate that the contact pressure increases with the torque applied on bolts. The contact pressure also increases with either an increase in the number of bolts, or a decrease in the surface roughness of contacting surfaces. The thermal contact resistance of bolted junctions depends strongly on the interfacial contact pressure. Correlation of interfacial pressure was developed in terms of the torque and bolt-joined parameters. Contact resistance correlation was expressed as a function of the contact pressure, surface roughness, and material properties. Both correlations were in reasonable agreement with the experimental data obtained in this study. The second part of this thesis was to study experimentally the thermal contact resistance and interfacial pressure of aluminum honeycombs. The honeycomb used in this study was made of Al3104-H19. The cell diameters of honeycombs were 6.3 and 12.7 mm. Temperature measurement shows that the temperature drop across the honeycomb sample is lower for the honeycomb with a smaller cell diameter. In order to further investigate the influence of sample heights on contact resistance, the honeycomb samples with two different heights were adopted. Results indicate that the total thermal conductance is higher for samples with a smaller cell diameter. The increase of the number of bolts leads to an increase of the total conductance. The contact resistance between aluminum honeycomb and aluminum alloy sample is about 7% of the total resistance. In addition, the contact resistance of honeycombs with a cell diameter of 6.3 mm decreased with the increasing torque. However, for the honeycombs with a cell diameter of 12.7 mm, the torque and the bolt pattern produce nearly no influence on the thermal contact resistance. The contact resistance is almost independent of the honeycomb height, but the total resistance decreases with increasing the height of samples.

Keywords : Thermal contact conductance, Bolted joint, Interfacial pressure, Pressure-measuring film, Contact resistance, Aluminum honeycomb.

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