RESEARCH ON THERMAL CONTACT RESISTANCE OF BOLT-JOINTED INTERFACE AND HEAT CONDUCTION HONEYCOMBS

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ABSTRACT

THIS THESIS IS DIVIDED INTO TWO PARTS: THE FIRST PART OF THIS THESIS IS "RESEARCH ON TH -ERMAL CONTACT RESISTANCE OF BOLT-JOINTED INTERFACE", AND THE SECOND PART OF THIS THESIS IS "RESEARCH ON HEAT CONDUCTION CHARACTERISTICS OF ALUMINUM HONEYCOMBS". THE FIRST PART OF THIS THESIS WAS AN EXPERIMENTAL STUDY OF THERMAL CONTACT CONDUCTANCE WHICH WAS CONDUCTED WITH PAIRS OF ALUMINUM ALLOY SPECIMENS (6061-T6) JOINTED BY BOLTS.TH -REE DIFFERENT BOLT PATTERNS AND THREE DIFFERENT BOLT-SHAFT DIAMETERS WERE ADOPTED IN TH -IS STUDY, AND THE TORQUE APPLIED ON EACH BOLT WAS BETWEEN 1 AND 10 N-M. A PRESSURE-MEAS -URING FILM WAS INSERTED BETWEEN SAMPLES TO DETERMINE THE INTERFACIAL CONTACT PRESSURE OF BOLT-JOINTED SPECIMENS. RESULTS SHOW THAT THE INTERFACIAL CONTACT PRESSURE INCREASES WITH AN INCREASE OF EITHER THE APPLIED TORQUE OR THE NUMBER OF BOLTS. THE INTERFACIAL TEMPERAT -URE DIFFERENCE ACROSS THE JUNCTION WAS SUBSTANTIALLY REDUCED FOR BOLT-JOINTED SPECIMENS, WHEN COMPARED WITH TWO SUPERIMPOSED SAMPLES WITHOUT BOLTS. WITH THE SAME BOLT NUMBER,THE VARIATION OF BOLT-SHAFT DIAMETER FROM 5 TO 8 MM YIELDS NEARLY NO INFLUENCE ON THE THERMAL CONTACT CONDUCTANCE. HOWEVER, WITH THE SAME BOLT SIZE, THE THERMAL CONTACT CONDUCTANCE OF SAMPLES JOINTED BY 8 BOLTS WAS MUCH LARGER THAN THAT OF 4-BOLT SAMPLES.THE INCREASE OF CO -NTACT SURFACE ROUGHNESS OF TEST SPECIMENS LEADS TO A DECREASE OF THERMAL CONTACT CONDUCT -ANCE.WHEN AN RTV SILICON LAYER WAS USED AS THE INTERSTITIAL MATERIAL,THE TOTAL JOINT CON -DUCTANCE WAS INCREASED WITH A DECREASE OF THE THICKNESS OF RTV SILICON LAYER. THE SECOND PART OF THIS THESIS WAS TO STUDY EXPERIMENTALLY THE HEAT CONDUCTION CHARACTE -RISTICS OF ALUMINUM HONEYCOMBS.THE HONEYCOMBS USED IN THIS STUDY WERE MADE OF AL3104-H19 AND AL3003-H16. THE CELL DIAMETERS OF HONEYCOMBS WERE 6.3 AND 12.7 MM.TEMPERATURE MEASURE -MENT SHOWS THAT THE TEMPERATURE DROP ACROSS THE HONEYCOMB SAMPLE IS LOWER FOR THE HONEYC -OMB WITH A SMALLER CELL DIAMETER. RESULTS INDICATE THAT THE AXIAL TOTAL THERMAL CONDUCTA -NCE IS HIGHER FOR SAMPLES WITH A SMALLER CELL DIAMETER. FOR HONEYCOMBS WITH DIFFERENT MA -TERIALS,THE AXIAL TOTAL CONDUCTANCES WERE VERY CLOSE IN THE TORQUE RANGE USED IN THIS ST -UDY.THE INCREASE OF EITHER THE NUMBER OF BOLTS OR THE BOLT-SHAFT DIAMETER LEADS TO AN IN -CREASE OF THE AXIAL TOTAL CONDUCTANCE.THE AXIAL CONTACT RESISTANCE BETWEEN ALUMINUM HONE -YCOMB AND ALUMINUM ALLOY SAMPLE ABOUT 10％OF THE AXIAL TOTAL RESISTANCE. IN ADDITION THE AXIAL 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.IN THE SAME DIRECTION OF THE ALUMINUM HONEYCOMB, THE CONTACT RESISTANCE IS ALMOST INDEPENDENT OF THE HONEYCOMB HEIGHT, BUT THE TOTAL RESISTANCE DECREASES WITH THE INCREASING HEIGHT OF SA -MPLES.

Keywords : THERMAL CONTACT CONDUCTANCE; BOLTED JOINT; INTERFACIAL TEMPERATURE DIFFERENCE;INTERFACIAL CONTACT PRESSURE; PRESSURE-MEASURING FILMS; CONTACT RESISTANCE; ALUMINUM HONEYCOMB; TOTAL CONDUCTANCE

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