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DEVELOPMENT OF AN INNOVATIVE TWO-PHASE FLOW COOLING SYSTEM ENHANCED BY A GRAPHENE EVAPORATIVE LAYER

Abstract

The development of a brand new generation of spacecrafts and satellites, based on the increasing

attention to their miniaturization for reducing costs and weights, without compromising the performances, led in the recent years to the birth of innovative space systems that can meet all the new requests of cost and weight reduction, compactness, high performances and reliability. In this scenario the design of new cooling systems appears as a primary importance issue. The present work, indeed, is part of the BaridiSana Research Activity - a joint project between the Italian Space Agency and Sapienza University of Rome, with the collaboration of ENEA, the Italian National Agency for New Technologies, Energy and Sustainable Economic Development - that lies in the research and development activity carried out by the United Nations Office for Outer Space Affairs (UNOOSA). The experiment was selected as one of nine scientific projects Planned for the China Space Station (CSS). In this paper the development of an innovative two-phase cooling system, based on the utilization of a graphene-coated graphite evaporative element is proposed, with a particular attention to its design, realization and testing. The graphite evaporative component is characterized by the presence of rectangular micro-channels that increase the surface for the heat exchange, and it is coated by a thin (<10 m) layer of graphene which enhances the bubble nucleation phenomenon, creating small cavities with high surface and thermal conductivity, in order to increase the heat transfer coefficient. The system was tested under different flow, thermal power and pressure conditions in order to characterize the evaporative element.