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BARIDI-SANA, A NEW TWO-PHASE FLOW COOLING SYSTEM FOR SPACE APPLICATIONS: DESIGN AND GROUND RESEARCH ACTIVITY FOR FUTURE ON-ORBIT OPERATIONS

Abstract

In recent years, the increasing attention to Space for scientific and commercial purposes has led to

a miniaturization of space systems and satellites themselves, meeting the new needs of reducing weights and costs, as well as a longer operating life. For this purpose, the quality and performance of the new generation of space systems are exponentially improved, the result of a new phase of space research. In this context, two-phase flow cooling systems assume great operational importance, meeting all new needs: low weight, compactness, reliability and high performances. In this study, the experimental activity related to the new two-phase flow cooling system, Baridi-Sana, is reported, starting from the system design, and arriving at the creation and testing of a facility for ground research activity, preparatory for the future operations in orbit. Baridi Sana, 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, is part of the research and development activity carried out by the United Nations Office for Outer Space Affairs (UNOOSA) and was selected as one of nine scientific projects Planned for the China Space Station (CSS) in 2022. The core of the system is a micro heat exchanger, MCMHE, characterized by the presence of a graphite element crossed by micro channels and covered by a thin layer of graphene, to improve boiling phenomena and thus heat exchange. The system has been tested under different flow conditions, from 5 l/h up to a maximum of 40 l/h, and with a thermal power up to 300 W at a pressure up to 2.5 bar. The results show an increase of the convective heat transfer coefficient under different heat flow conditions and patterns.