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Author: Prof. Maaza Malik
National Research Foundation (NRF), South Africa, Maaza@tlabs.ac.za

THERMOCHROMIC BASED SMART COATING FOR THERMAL REGULATIONS AND HEAT MANAGEMENT IN SPACECRAFT/SATELLITE UNITS

Abstract

Because of the extreme and cycling temperature environment on Earth orbits, thermal control for spacecraft-satellites is always needed to provide a regulated temperature environment for onboard instruments and electronic devices to function prpperly during all phases of the spacecraft's/ satellite's mission. Radiator i.e a thermal louver to eject heat into deep space, a heater and associated control unit constitute a standard conventional thermal control sub-system. However, such thermal control subsystemcan be heavy and expensive, specifically for high power consumption spacecraft. As the density of instruments on the space craft tends to be high and the mission to be complex, thermal control subsystemof higher performance in terms of mass, design simplicity, and cost than the conventional technique would be needed.To meet these requirements, 2 key technologies are currently under consideration; MEMS based micro-mechanical louver [1] and the smart radiator using either thermochromic or electriochromic smart coatings [2].Among this latter class, VO2 based smart coatings are by far the most considered modern option by NASA [3], ESA [4], JAXA [5] and the Canadian Space Agency [6]. VO2 is a typical thermochromic material, which can change its thermal emmitance, also the transmittance and reflectance in the Infrared region in particular, due to a reversible metal-insulator phase transitionupon the change of envirnoment temperature. Such active, and with no required energy input tunable property can be effectively used to regulate heat rejection by the spacecraft/satellite. This contribution reports on physical properties of VO2 coatings synthesized by various methodologies. In addition, the effects of various radiations simulating deep space environment such as light elements irradiations and very short wavelength radiations are reported in relation to the lifetime of such smart coatings..

[1]: www.crcnetbase.com/doi/pdf/10.1201/9781420027747.ch9 [2]: doi.ieeecomputersociety.org/10.1109/ICMENS.2004
[3]: NASA Technical Reports, NASA/CR-2001-211411 by R.J. Mell and G.E. Wertz. [4]: ESA TENDER:http://emits.esa.in
09.129.26$user$[5]; $JAXAREPORT$: $airex.tksc.jaxa.jp/pl/dr/$19980209972[6] : $CanadianSpaceAgency, R.Kruzeleckyet$