SMART THERMAL CONTROL SKIN ASSISTED BY ELECTRICALLY TUNNING NEAR-FIELD PHOTON TUNNELLING

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Thermal control is of critical importance for normal operation of spacecraft which undergoes everchanging and complicated thermal environment. An efficient approach is to coat a tunable-emittance "skin" that can tune its heat dissipation according to various thermal conditions. Existing schemes are difficult to combine the advantages of all-solid-state structure, actively and accurate tuning, and large tuning range of heat flux. New approaches need to be developed.

In this poster, we report our recent researches on a brand-new thermal control scheme—near-field radiation assisted smart skin. Our idea is to introduce a nanoscale vacuum gap into the functional skin and, by efficiently tuning the photon tunneling through electric field effect, the thermal resistance of the skin can be tuned, further the rejected heat flux (see Fig.1). Based on this idea, we propose a new optoelectronics prototype, photonic *p-n* junction, which coordinate holes and electrons to switch the photon-carrier interaction among three fundamental modes and in turn largely tune the photon tunneling (see Fig.2).

We are now devoted to bring our thought from theoretical level to experimental verification, and in near future, towards the actual application in space engineering, thus opening a new avenue for spacecraft thermal control.

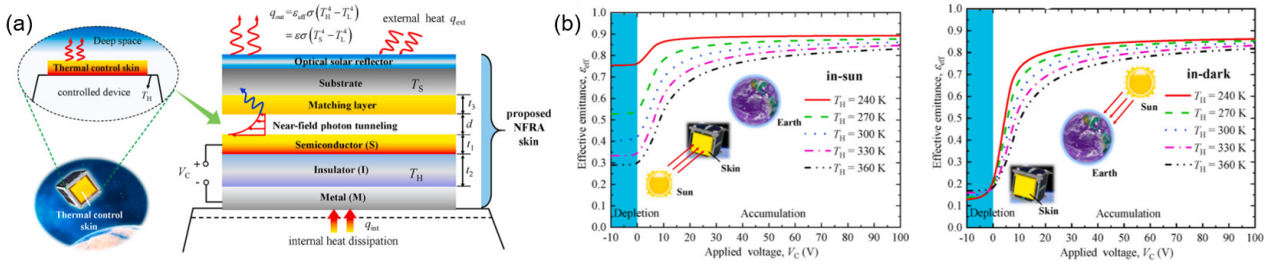

Fig.1 Concept (a) and performance (b) of the near-field radiation assisted thermal control skin for spacecraft [1]

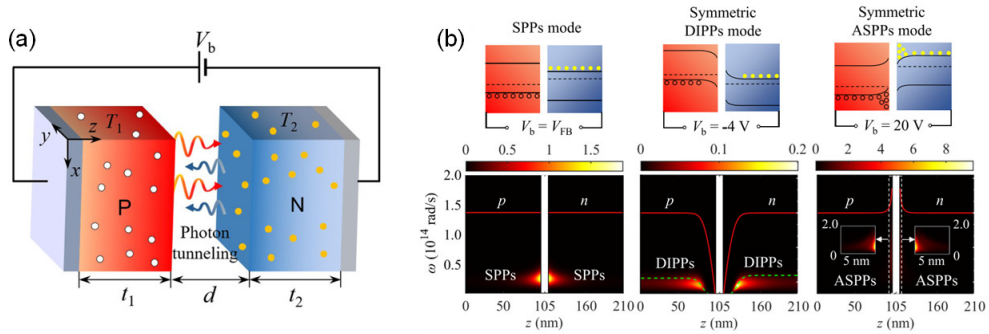

Fig. 2 Photonic *p-n* junction (a) concept (b) three electrically tunable plasmon modes [2]

[1] Xu et al. *International Journal of Thermal Sciences*, 2021, 165: 106934.
[2] Xu et al. *Physical Review B*, 2022, 106: L121403.

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