Surface thermal inertia of near-Earth asteroid (469219) Kamo'oalewa: Statistical estimation and implications

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The Chinese small body exploration mission Tianwen-2 is aimed at sampling the near-Earth, fast-rotating asteroid (469219) Kamo'oalewa and returning the samples to Earth. Characterisation of the currently unknown physical properties of Kamo'oalewa in the pre-mission phase would support mission implementation. In this study, we preliminarily estimate the surface thermal inertia of Kamo'oalewa using a statistical method, based on the Yarkovsky-related orbital drift of (-6.155 ±1.758) $\times 10^{-3}$ au/Myr for Kamo'oalewa obtained in our previous work. A reasonable estimate of the surface thermal inertia obtained is 402.05_{-194.37}^{+376.29} J K^{-1} m^{-2} $s^{-1/2}$. This low value suggests the presence of coarse regolith on the surface of Kamo'oalewa or its nature as a porous rock. The regolith potentially present on the surface of Kamo'oalewa may have millimetre- to decimetre-sized grains with cohesive strengths varying from ~0.76 Pa to 0.045 Pa. If Kamo'oalewa is a porous rock, its porosity is expected to range from ~20% to 50%, corresponding to tensile strengths of ~1.3 to 11.5 MPa. This study provides preliminary insights into the surface thermal inertia of Kamo'oalewa from a statistical viewpoint, which may facilitate the Tianwen-2 mission.

Keywords: Thermal inertia, Kamo'oalewa, Yarkovsky effect, Chinese Small Body Exploration Mission

