Omnidirectional Light Absorber with Gold-coated Hierarchical Nanoturfs for Solar-Thermal Conversion

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Although much attention has been paid to the development of photothermal materials and designs that can convert solar irradiation into exploitable thermal energy, it remains some obstacles such as limited light absorbing band and narrow incident angle. This study proposes a black gold-coated hierarchical nanoturf (Au/h-nanoturf) membrane incorporated with randomly distributed high aspect ratio (AR) nanostructures and micro-through holes. Thanks to structural advantages, this large area membrane exhibited good absorption of the broadband solar light spectrum. The h-nanoturf is further combined with a microcone array to enhance solar absorption extended to the near-infrared range as well as the omnidirectional incident direction of the light. The fundamental mechanism of the strong omnidirectional broadband absorption performance of the h-nanoturf was thoroughly analyzed with computational electrodynamics simulations. Consequently, we employed the Au/3D h-nanoturf with microscale hole (μ-hole) membrane to fabricate an advanced solar-vapor generator.