MATERIALS PLATFORM FOR FLEXIBLE EMISSIVITY ENGINEERING

Tech ID: 30559 / UC Case 2020-010-0

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Published Application	20230033524	02/02/2023	2020-010

BRIEF DESCRIPTION

This materials platform enables flexible engineering of infrared (IR) emissivity and development of thermal radiation devices beyond the Stefan-Boltzmann law. The materials structure is based on thin films of vanadium oxide (VO2) with judiciously designed graded W doping across a thickness less than the skin depth of electromagnetic screening (~100 nm). The infrared emissivity can be engineered to decrease in an arbitrary manner from ~ 0.75 to ~ 0.35 over a temperature range up to 50 C near room temperature. The large range of emissivity tuning and flexible adjustability is beyond the capability of regular materials or structures. This invention provides a new platform for unprecedented manipulation of thermal radiation and IR signals with a wide variety of applications, such as:

The emissivity can be programmed to precisely counteract the T^4 dependence in the Stefan-Boltzmann law and achieve a temperature dependent thermal radiation. Such a design enables a mechanically flexible and power-free infrared camouflage, which is inherently robust and immune to drastic temporal fluctuation and spatial variation of temperature.
By tailoring structure and composition, the materials platform can create a surface with robust and arbitrary IR temperature image, regardless of the actual temperature distribution on the targets. This design of infrared "decoy" not only passively conceals the real thermal activity of the object, but also intentionally fools the camera with a counterfeited image.
The materials platform can achieve strong temperature dependence of reflectivity over a broad wavelength from near-IR to far-IR, which is promising for high-sensitivity remote temperature sensing by thermoreflectance imaging, or active reflectance modulation of IR signals.

SUGGESTED USES

» The materials platform can be used to design and produce a mechanically flexible and power-free thermal IR camouflage, which is beyond the capability of traditional camouflage technology due to its inherently robustness and immunity to drastic temporal fluctuation and spatial variation of temperature. The product can be applied in counter-surveillance and military defense.

» The materials platform can be used to create an artificial surface with counterfeited IR image to fool cameras, regardless of the actual temperature profile on the targets. This IR "decoy" technology can be applied in military defense and counter-terrorism.

» The materials platform can be applied to remote temperature sensing by thermoreflectance. The high temperature sensitivity and spatial resolution is beneficial for non-invasive micro-scale analysis in industry, academia, and commerce.

» The materials platform can produce tools with active and fast modulation of IR and tetrathertz signals, which have strong potential for academic research, non-invasive detection, and wireless communication.

ADVANTAGES

The large range of emissivity tuning and flexible adjustability is beyond the capability of regular materials or structures. This invention provides a new platform for unprecedented manipulation of thermal radiation and IR signals with a wide variety of applications.

RELATED MATERIALS

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

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OTHER INFORMATION

KEYWORDS

materials platform, metal-insulator transition, emissivity engineering, reflectance manipulation

CATEGORIZED AS

» **Optics and Photonics**

» All Optics and Photonics

» **Engineering**

» Engineering

» **Imaging**

» Other

» Remote Sensing

» Security

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