A WEEKLY INFORMATION LETTER 08TH MAY, 2017

NEWSLETTER

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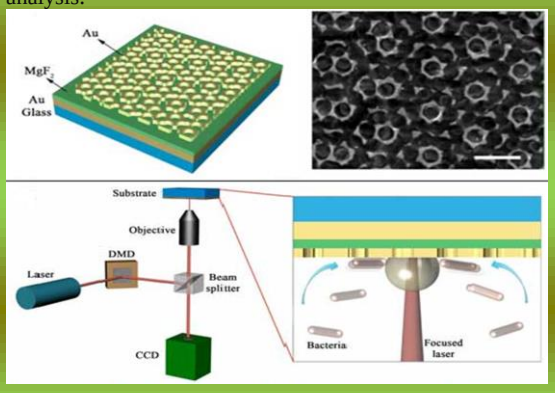
ADVANCEMENTS IN NANO TECHNOLOGY

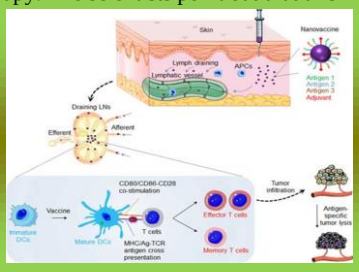
A multifunctional biophotonic platform enabled by moire metasurfaces

Researchers demonstrate for the first time a multifunctional biophotonic platform enabled by the multiband resonance peaks of the plasmonic moiré metasurfaces. In their work, a sandwich-like metal-insulator-metal (MIM) structure is created, where a gold moiré metasurface is placed on top of a gold thin film with a MgF2 layer as a spacer between them. Benefiting from the multiband nature of moiré metasurface and the near-field enhancement from the MIM configuration, a dual-band metasurface patch with strong plasmonic resonances at both near-infrared (~1300 nm in wavelength) and mid-infrared (~5 μm in wavelength) regimes was achieved. The metasurface fabricated by moiré nanosphere lithography, a cost-effective fabrication method to obtain moiré patterns, consists of plasmonic nanostructures that support plasmon resonances at different wavelengths due to the gradient in size and shape. The broadband absorption in near-infrared (NIR) regime enables the high versatility in choosing working lasers with wavelengths from 1.2 to 1.6 μm for the photothermal treatment. In addition, the gold moiré metasurface patch is also promising for mid-infrared (MIR) sensing due to the strong plasmonic resonance at ~5 μm. The researchers have made use of the dual-band properties of this plasmonic platform for several biomedical applications, including infrared sensing, optical capture and immobilization of bacteria, photothermal denaturation and spectroscopic analysis of proteins. Researchers immersed the metasurface patch in a solution containing bacteria and then shined a NIR laser on the substrate. The plasmon-assisted heating effect quickly increases the localized temperature at the laser spot and generates a micro-bubble that can capture the suspending bacteria to the substrate. The photothermal effect at NIR regime can be further combined with the strong plasmonic resonance at MIR regime to denaturalize proteins and subsequently perform in situ spectroscopy analysis.



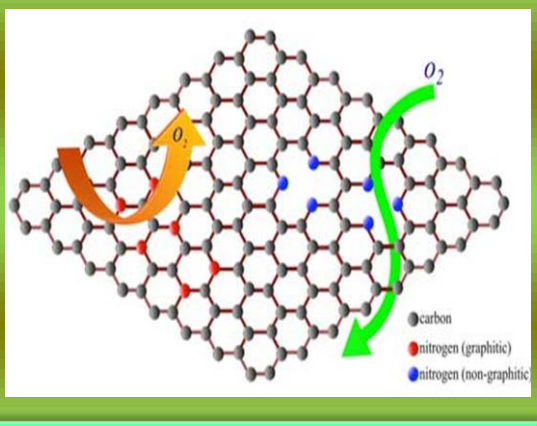
Nanotechnology vaccines in cancer immunotherapy

Immunotherapy has become an important part of treating some types of cancer. It uses certain parts of a person's immune system to fight the cancer. Usually this is done by administering immune system components, such as man-made immune system proteins. Tumors evade the immune system by suppressing its ability to recognize and kill cancer cells. The goal of immunotherapy is to normalize and harness the body's immune system so that it can more effectively fight the tumors. In recent years, nanotechnology has played an increasingly important role in pursuing efficient vaccine delivery in cancer immunotherapy. For instance, a proof-of-principle study has shown that nanoparticle-programmed immune cells, known as T cells, can rapidly clear or slow the progression of leukemia in a mouse model. In another study, researchers had initial success in mice using nanodiscs to deliver a customized therapeutic vaccine for the treatment of colon and melanoma cancer tumors. Yet another study showed that magnetic nanoparticles could be key to effective immunotherapy. Nanotechnology vaccines are also expected to facilitate the evaluation and application of cancer therapeutic neoantigen and in vitro transcribed mRNA (IVT-mRNA) antigen, which are two classes of antigens that have recently been extensively explored for cancer immunotherapy. The scientists point out that this IVT-mRNA vaccine is an emerging candidate enthusiastically pursued for cancer immunotherapy, yet the delivery of naked mRNA, like other therapeutic nucleic acids such as siRNA and plasmids, can be a daunting challenge. Nanomaterials show promise in improving the efficiency of IVT-mRNA delivery by protecting mRNA from nuclease degradation, enhancing mRNA delivery to lymphoid organs, such as lymph nodes and spleens, and facilitating intracellular delivery of mRNA to antigen-presenting cells.



Defects in graphene enable selective permeability of gases

Future electric vehicle technologies literally need a fresh breath of air. Li-O2 batteries, which store and deliver energy much higher than the present Li-ion technologies by drawing oxygen from air, are touted as the panacea for powering electric vehicles. Researchers have discovered a way to make the thinnest possible oxygen selective membrane using graphene. Defects are often written off in materials as performance limiters. Researchers identified specific defect configuration that could be used for tailoring the permeability of graphene. Their work showed that nitrogen dopants can be used to turn otherwise impermeable graphene into an oxygen selective membrane. In its pristine/perfect atomic configuration, graphene is impermeable to all gases. But, pores in graphene can selectively allow the transport of gas/water molecules. Researchers developed an in situ technique to induce pores in graphene by doping it with nitrogen during the growth process. Graphene, an atom-thick layer of carbon, chemically grown on a copper foil protects it from oxidation by forming an impermeable barrier. Doping the graphene sheet with nitrogen inevitably breaks some carbon bonds in graphene opening nanoscopic pores. And researchers observed that such pores in doped graphene selectively allow oxygen leading to oxidation of the underlying copper foil unlike pristine graphene.



Nano products

Amsoil® Ea Air Filters

This product is from the company Amsoil®, USA. The revolutionary nanofiber technology used in AMSOIL Ea Filters captures more dirt, holds more dirt and allows better air flow than conventional air filters. Surface bound nano particles were present in these filters which are efficient in purifying air.

Antifreeze

This is the product of Nano-Shops company from Germany. Percenta Nano Antifreeze is especially designed for glass surfaces, which have been treated with the Percenta nano sealant. Nano particles are suspended in a solution which are used as sealants in automobiles and other applications.