

Nanotechnology for security and defense

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Abstract

In recent years, emerging technologies are becoming of great interest due to the possibility of developing applications which can improve the features of the existing ones, and even, there is the possibility of developing novel applications that cannot be achieved without these.

Usually, there are two different ways of developing applications: a bottom-up approach, starting from the development of science and technology to assess its properties and create an application from them. A top-down approach, on the other hands, starts with a real problem that needs a specific application, and then seeks for the most optimal technology that can create an application to solve that problem.

With this end-user point of view, Ministry of Defense has defined several sectors of interest[1], in which different kind of technologies can provide the means to develop the required applications, and among them, nanotechnology, and more specifically photonics and new emerging fields like metamaterials and plasmonics are expected to play an important role.

Applications related to light guiding, multispectral sensing, lensing, and reduction of scattered light can be achieved using metamaterials. These are artificial materials[2] whose optical properties are solely determined by the fabricated microstructure, making it possible to the control the dielectric permittivity (ϵ) and magnetic permeability (μ) to achieve unusual properties such as negative refraction at certain wavelengths. Combined with Transformation Optics[3], these new materials allow an accurate control of the flow of light. This unique properties of metamaterials make them also attractive to be used in security features like of bank notes, passports or ID cards.

Fast and accurate detection of biological or chemical agents is a topic of great interest in the field of security. IR spectroscopy is one of the most promising technologies for this application, since it allows the detection of IR signatures to be compared with databases to identify the threat. Also, the interaction of agents with sensing surfaces can change the optical properties, making it suitable for the use of plasmons in this kind of detection.

References

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