OAK RIDGE NATIONAL LABORATORY FACT SHEET
MANAGED BY UT-BATTELLE FOR THE DEPARTMENT OF ENERGY

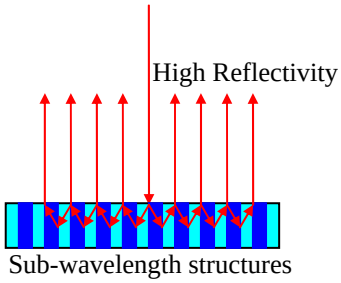
Highly Reflective Sub-Wavelength Structures For Homeland Security Initiatives

New and Exciting Smart Optical Technology

Through a newly founded Photonics program, Oak Ridge National Laboratory (ORNL) researchers are developing, smart optical sensors to respond reliably, accurately, and quickly in harsh conditions. These discrete sensors can be fabricated on a scale so small, that they are undetectable by the human eye and can be optically detected from distances over several km away in adverse environmental conditions.

Applications

- Remote tracking, tagging locating and identification
- Versatile sensors with scalable properties
- Customized optical surfaces with wavelength selectivity
- Bio-terrorism sensor



Description

Sub-wavelength structures are customized optical surfaces, which, when illuminated with light of a specific wavelength become highly reflective. Unlike other retro-reflectors, mirrors, and reflective paints, these sub-wavelength structures, if designed correctly, can offer high reflectivity, without limited wavelength selectivity, polarization selectivity, and angular sensitivity. The structures are essentially located in microscopic optical waveguides, with imprinted features, having dimensions smaller than the wavelength of the incident light. Sub-wavelength optical structures can be created with high reflection coefficients in the infrared (IR) where long-range propagation (>5km) of light in the atmosphere is possible, and where environmental conditions such as fog, smoke and dust do not impede the penetration. Thus applications of tags include remote identification, tracking and locating at distances. Furthermore, at different wavelengths, changes in the reflected intensity can indicate the presence of gases commensurate with a bio-terrorism sensor.

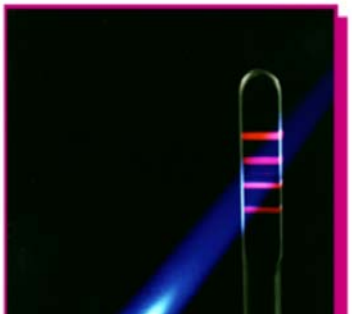
Point of Contact:
Marc Simpson
Engineering Science and Technology Division
Oak Ridge National Laboratory
P. O. Box 2008
Oak Ridge, TN 37831
Tel: 865 574 4171
Email: simpsonml@ornl.gov

"*Biological weapons are potentially the most dangerous weapons in the world…We must be better prepared to prevent, identify and respond.*"
George W. Bush-Signing of Public Health Security and Bio-terrorism Bill, 6.12.02.

Advanced Lasers, Optics, and Diagnostics Group:
http://www.ornl.gov/lod

Fluorescent Tags from Phosphors

- Fluorescent coatings of phosphor materials can provide a viable means for tagging objects of interest.
- Phosphors are fine white powders which efficiently luminesce.
- They are durable and chemically inert

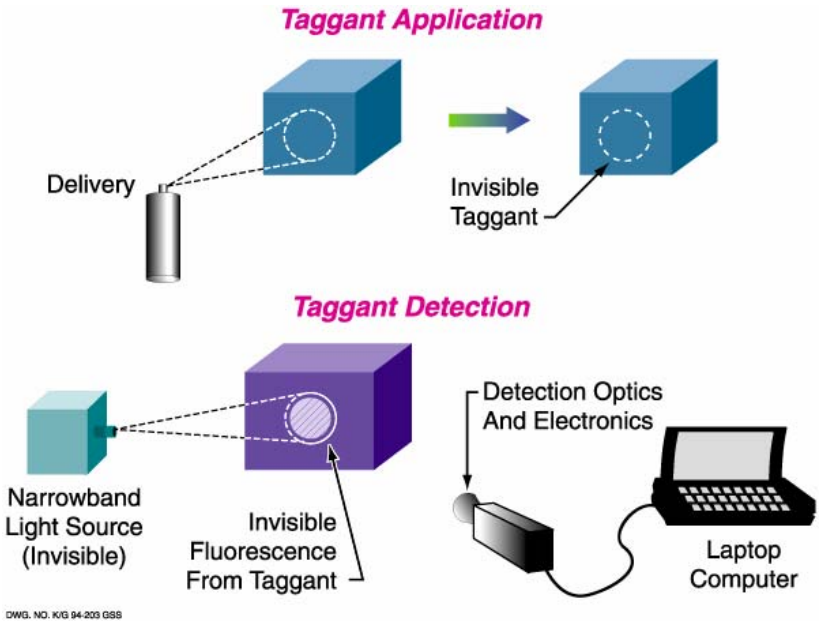


Coating visible through flame.

Designer Phosphors
Fluorescent paints can be specified for any portion of the spectrum: ultraviolet, visible, and infrared.

Long-Lived Phosphors

Now long-lived phosphors are available which can fluoresce for up to 16 hours after being charged by sunlight or room light. These would be passive tags.



Points of Contact:

Steve Allison
Sr. Development Staff
Advanced Lasers and Optics
Oak Ridge National Laboratory
Bethel Valley Road MS-6054
Oak Ridge, TN 37932-6054
Phone: 865-576-2725
FAX: 865-576-0279
E-mail: allisonsw@ornl.gov

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