Multifunctional Optical Coatings by Rapid Self-Assembly

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Problem

Optical coatings are ubiquitous, appearing on items that range from electronic devices, photographic lenses, and windows to aircraft sensors, photovoltaic cells, and lightweight plastic goggles for troops in the field. The coatings are applied to materials such as glass and ceramics, which protect or alter the way the material reflects and transmits light. However, the two main methods of applying these coatings – sputtering and chemical vapor deposition (CVD) – are expensive, require highly specialized personnel, and can be hazardous due to the extreme conditions required for the processes. Sandia has developed a technique for applying optical coatings that eliminates these problems. The Multifunctional Optical Coatings by Rapid Self-Assembly process takes place at room temperature using ambient conditions, yet produces a coating competitive with current technologies.

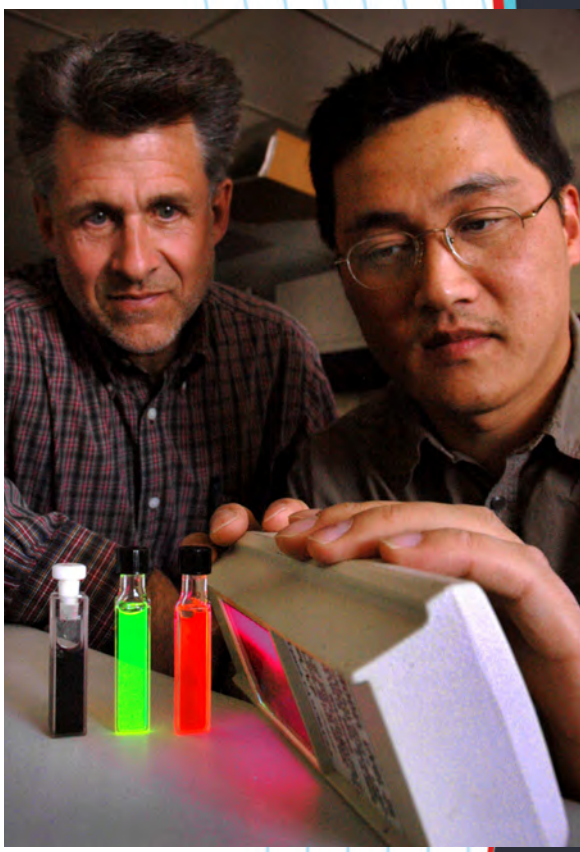
Innovative Edge

Sandia's method for applying the film uses commercially available polymers, dissolving them in common solvents at a normal temperature and pressure, and then using a simple spin, dip, or spray technique to coat the surface. Evaporation of the solvents induces self-assembly, forming multifunctional films with a nanostructured surface, low surface energy, controllable porosity, and a specific desired refractive index. Using a variety of near-ambient processes, the chemical and physical nature of the polymer film can be modified to provide different functions and properties depending on the application. The ability to adjust the material parameters of the film at different stages (synthesis, deposition, or post-deposition) provides a powerful new degree of freedom. In addition, Sandia's method is compatible with conventional spray processing and, therefore, is not subject to the equipment and facility limitations of traditional deposition processes. This allows a wider range of applications, including the coating of large or complex parts.

Commercialization & Industry Impact

Sandia developed the 2010 R&D 100 award-winning Multifunctional Optical Coatings process in conjunction with Lockheed Martin through a Cooperative Research and Development Agreement (CRADA). The goal of the partnership was threefold: to develop the technology; to identify applications for industry, the DoD, DOE and NASA; and to integrate the technology into current product lines. Applications for the coatings range from reducing corrosion on aircraft transparencies and architectural windows to protecting photovoltaics.

Other areas that could benefit from this coating process include high-definition flat panel displays, sensor coatings for both biological and chemical sensors, and low-k materials for next generation memory chips.



Jeff Brinker (left) and Hongyou Fan observe satisfactory fluorescence by their well-trained nanocrystals in water solution. The dark vial holds gold nanocrystals; the orange and green are semiconductor nanocrystals.