Magnetic Assembly Of Nonmagnetic Particles Into Photonic Crystal Structures

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OTHER INFORMATION

KEYWORDS

Self-assembly, ferrofluid, magnetic hole, colloids, photonic crystaals, nanocrystals

CATEGORIZED AS

- **Optics and Photonics**
  - All Optics and Photonics
- **Nanotechnology**
  - Materials
- **Sensors & Instrumentation**
  - Environmental Sensors
  - Other
  - Scientific/Research

RELATED CASES

2011-245-0

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	9,341,742	05/17/2016	2011-245

FULL DESCRIPTION

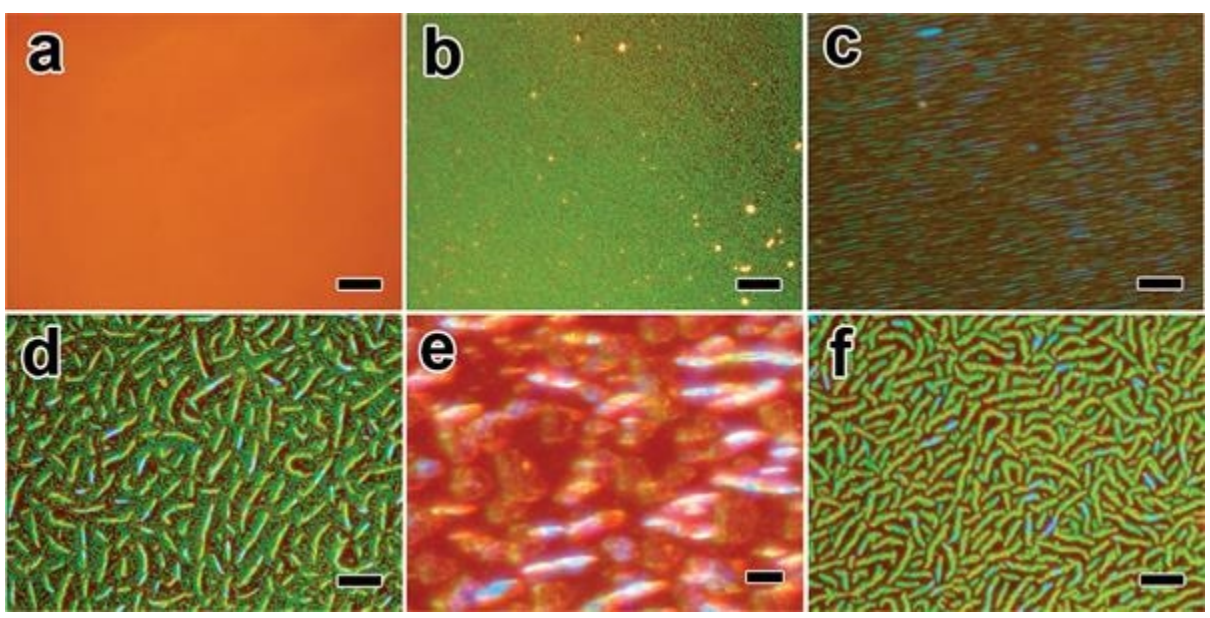
Background

Photonic crystal structures in 1-, 2- and 3-dimensions offer interesting and attractive opportunities for the control and manipulation of light. Photonic band gap fibers when properly designed can confine light in a lower index core or even a hollow core (air or gas). Bandgap fibers with hollow cores can, for example, support the creation of fibers that guide light in wavelengths for which transparent materials are not available. Practical application of photonic crystals, especially those with bandgaps in the visible range, has been limited by the low efficiency and high cost involved in conventional lithographic fabrication techniques.

A significant challenge with self-assembly methods that have been developed to date is that the formation of high-quality colloidal crystals over a large area are usually time consuming and therefore suffer from low production efficiencies.

Current Invention

Inventors at UCR have been able to develop a process for the rapid formation of photonic crystal structures by the assembly of uniform nonmagnetic colloidal particles in ferrofluids using external magnetic fields.



Optical microscope images of the assembly of 185 nm polystyrene beads dispersed in the ferrofluid in a 30 micron thick fluid film sandwiched between two glass slides under different magnetic fields. (a) 0 G and 0 G/cm; (b, c) 300 G and 580 G/cm; (d, e) 500 G and 982 G/cm and (f) 1500 G and 2670 G/cm. The field direction is parallel to the viewing angle in (a, b, d, f), but tilted for ~ 15 degrees and 60 degrees away from the viewing angle in (c) and (e) respectively. All scale bars are 20 microns except 50 microns for (e).

Taking advantage of the superior stability of highly surface-charged magnetite nanocrystal based ferrofluids, the inventors at UCR have been able to successfully assemble nonmagnetic polymer beads (185 nm in size) into photonic crystal structures – from 1-dimensional chains to 3-dimensional assemblies.

ADVANTAGES

- 3D photonic crystals with high reflectance (83%) in the visible range can now be rapidly produced within several minutes.
- Easily scalable process.
- Method can be extended to assembly of building blocks with different compositions and morphologies.

SUGGESTED USES

- Color display devices
- Sensors
- Active optical components
- Photonic band gap fibers

RELATED MATERIALS

- Magnetic Assembly of Nonmagnetic Particles into Photonic Crystal Structures

INVENTIONS BY PROF. YADONG YIN

Please see all inventions by Prof. Yadong Yin and his team at UCR

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