



# Magnetically Responsive Photonic Nanochains

Tech ID: 32615 / UC Case 2011-499-0

## PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	9,180,484	11/10/2015	2011-499

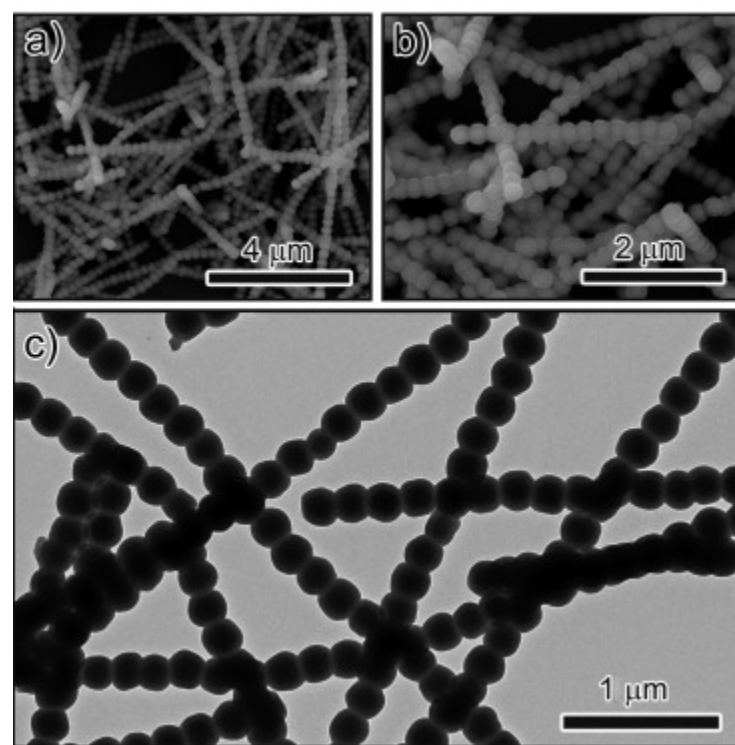
## FULL DESCRIPTION

### Background

Responsive photonic materials are of great interest owing to their broad applications that are relevant to the controlling of colors. Being efficient and inexpensive, colloidal self-assembly has been widely studied for the fabrication of photonic crystal structures, especially for applications that can tolerate defects. The ideal case is to fix individual magnetic particle chains, which will produce the smallest possible photonic nanostructures that can effectively diffract at visible spectrum.

### Current Invention

At UCR, inventors have developed a convenient and flexible approach for the fabrication of individually fixed nanochains with a magnetically responsive photonic property by combining magnetic assembly with sol-gel processes. The process is highly controllable: the periodicity can be varied by using  $\text{Fe}_3\text{O}_4$  colloidal nanoclusters (CNCs) of different sizes, the interparticle spacing can be fine-tuned by adjusting the timing of magnetic field exposure, and the length of the chains can be controlled by changing the duration of the magnetic field exposure. The resulting photonic chains disperse randomly in solution in the absence of a magnetic field but align themselves and show diffraction color instantly when an external field is applied. The fixed photonic nanochains exhibit long-term structural/ optical stability and can be conveniently incorporated into many liquid or solid matrices.



a, b) SEM and c) TEM images of typical photonic nanochains. The particle chains are permanently fixed by silica coating so that they remain stable when dispersed in solution or dried on solid substrates.

## CONTACT

Venkata S. Krishnamurty  
[venkata.krishnamurty@ucr.edu](mailto:venkata.krishnamurty@ucr.edu)  
 tel: .

## OTHER INFORMATION

### KEYWORDS

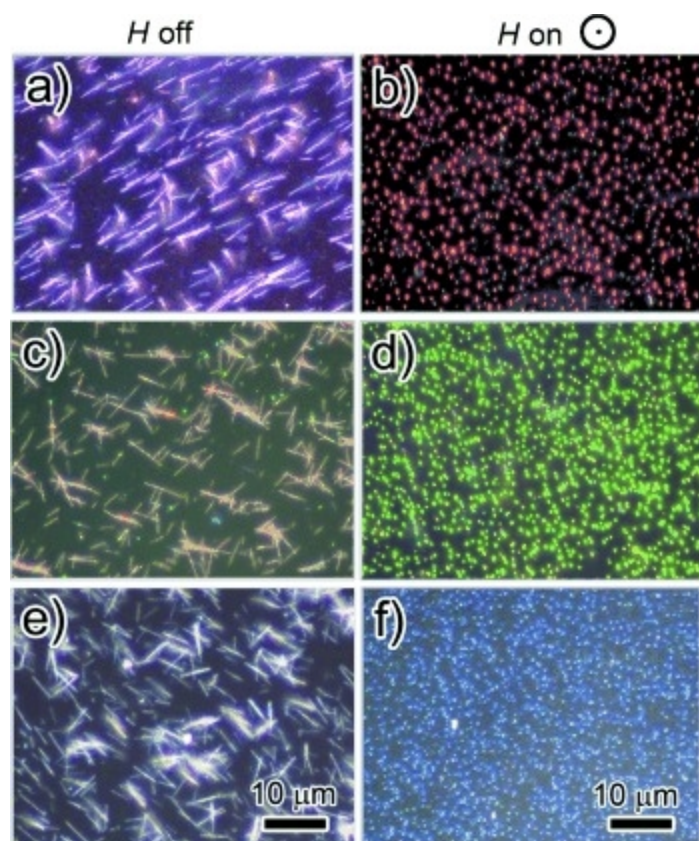
Magnetic properties, Nanomaterials, Photonic crystals, self assembly, Sol-gel process, Color displays, Biosensors, Chemical sensors, Biomedical Imaging

### CATEGORIZED AS

- ▶ **Optics and Photonics**
  - ▶ All Optics and Photonics
- ▶ **Imaging**
  - ▶ Medical
- ▶ **Materials & Chemicals**
  - ▶ Chemicals
  - ▶ Nanomaterials
- ▶ **Medical**
  - ▶ Diagnostics
  - ▶ Imaging
  - ▶ Research Tools
- ▶ **Nanotechnology**
  - ▶ Materials
  - ▶ Tools and Devices
- ▶ **Sensors & Instrumentation**
  - ▶ Analytical
  - ▶ Biosensors

### RELATED CASES

2011-499-0



Dark-field optical microscopy images of magnetic photonic chains with different diffraction colors switched between "off" (a, c, e: without magnetic field) and "on" (b, d, f: with vertical magnetic field) states. These photonic chains diffract at different wavelengths because they were prepared using Fe<sub>3</sub>O<sub>4</sub> CNCs of different average sizes: a, b) 182 nm, c, d) 160 nm, e, f) 113 nm. All images are at the same scale.

## ADVANTAGES

- ▶ The diffraction wavelength of these photonic chains can be tailored across the visible spectrum.
- ▶ The chain length and interparticle separation can be conveniently controlled.
- ▶ Fast on/off switching and tolerant to environmental variances.
- ▶ Excellent mechanical and optical stability.

## SUGGESTED USES

- ▶ Color displays
- ▶ Biological and Chemical sensing
- ▶ Biomedical imaging
- ▶ Biomedical labeling

## RELATED MATERIALS

- ▶ [Magnetically responsive photonic nanochains](#)

## INVENTIONS BY PROF. YADONG YIN

Please see all [inventions by Prof. Yadong Yin and his team at UCR](#)

University of California, Riverside  
 Office of Technology Commercialization  
 200 University Office Building,  
 Riverside, CA 92521  
[otc@ucr.edu](mailto:otc@ucr.edu)  
[research.ucr.edu/](http://research.ucr.edu/)