

What is a photonic crystal?

As mentioned above, a photonic crystal is a material whose dielectric function varies periodically, therefore: where \mathbf{R} is a lattice-translation vector, equal to $l_1\mathbf{a}_1 + l_2\mathbf{a}_2 + l_3\mathbf{a}_3$ where l_1, l_2 , and l_3 are integers.

Can photonic crystal optics be useful for OPAL research?

This review presents several of these applications and an accessible overview of the physics of photonic crystal optics that may be useful for opal and inverse opal researchers in general, with a particular emphasis on the recent use of these three-dimensional porous structures in electrochemical energy storage technology.

What are photonic crystal films used for?

We believe that these single and multistacked photonic crystal films with high reflectivity have potential for a variety of applications, such as optical filters, reflectors, and anticounterfeiting optical barcodes as well as structural colorants and colorimetric sensors 10, 40, 41, 42, 43.

What if a photonic crystal is placed in an air medium?

If the photonic crystal is placed in an air medium ($n_1 = 1$) and a first-order resonance ($m = 1$) is being measured, this equation can also be seen represented as: The authors acknowledge support from the Irish Research Council Government of Ireland Postgraduate Scholarship under award no. GOIPG/2016/946.

How are superparamagnetic non-close packed photonic crystals made?

Asher et al. assembled superparamagnetic non-close packed photonic crystals using highly charged superparamagnetic polystyrene-iron oxide composite colloidal particles, fabricated by the emulsion polymerization of styrene in the presence of ~ 10 nm iron oxide particles.

How do photonic crystals affect photon propagation?

Efforts to achieve all-optical integrated circuits have led to a growing interest in the fabrication and use of photonic crystals (PhCs); PhCs have a periodic variation in dielectric function that affects the propagation of photons much like the periodic potential in semiconductors affects the flow of electrons.

Hydrophobic fluorinated colloidal photonic crystals for heterogeneous aggregated cluster encoding and energy-saving applications. Author links open overlay panel Tong-Bo Chen b, Qiu-Ning Li b, ... anticounterfeiting and information storage, as well as the energy-saving optoelectronic devices. Graphical abstract.

Many Facets of Photonic Crystals: From Optics and Sensors to Energy Storage and Photocatalysis. Alex Lonergan, Alex Lonergan. School of Chemistry, University College Cork, Cork, T12 YN60 Ireland. ... There are a number of structures that fall into the category of a photonic crystal; 1D, 2D, and 3D ordered structures can qualify as a photonic ...

Solar energy, as a renewable and sustainable resource, presents a cost-effective alternative to conventional energy sources. However, its intermittent nature necessitates ...

These applied scientific advances may be feasible by adapting the physics of photonic crystals to materials science and electrochemistry for promising battery and energy storage materials, and as a new series of electro-optic probes ...

2D and 3D photonic crystal materials for photocatalysis and electrochemical energy storage and Science and Technology of Advanced Materials (IF 7.4) Pub Date : 2016-09-16, DOI: 10.1080

A ZnO:Al IO in a tandem solar cell between a-Si:H and mc-Si:H layers reported an enhancement factor of 3.6 in the external quantum efficiency of the limiting a-Si:H layer by acting as wavelength selective filter; high energy wavelengths were ...

Silicon oxidation plays a critical role in semiconductor technology, serving as the foundation for insulating layers in electronic and photonic devices. This review delves into the potential of silicon nanoparticles and microparticles ...

The ability to selectively redirect specific wavelengths of light has attracted a lot attention for photonic crystal materials. Presently, there is a wealth of research relating to the fabrication and application of photonic crystal materials.

Photonic Crystals: Arrays of nanopores can be used to create photonic crystals, which manipulate light in unique ways for applications in optical computing, telecommunications, and sensing. Enhanced Capacitors and Batteries : Nanoporous materials significantly increase the surface area for charge storage, leading to higher energy and power ...

(Photonic Crystals, PhCs),(Photonic Band Gap, PBG)"",, ...

(c) Photonic band gap structure diagram for a g-al 2 o 3 inverse opal showing a pseudo photonic bandgap between the second and third bands along the L -> G direction (i.e. [111] direction).

Topological photonic sensors have emerged as a breakthrough in modern optical sensing by integrating topological protection and light confinement mechanisms such as topological states, quasi-bound states in the continuum (quasi-BICs), and Tamm plasmon polaritons (TPPs). These devices exhibit exceptional sensitivity and high-Q resonances, ...

Progress towards all-optical integrated circuits may lie with the concepts of the photonic crystal, but the unique optical and structural properties of these materials and the convergence of PhC and energy storage disciplines may facilitate further developments and

Energy bands in photonic crystals. ... Photonic crystals can be used as chemical sensors for sensing the pH and ionic strength of solutions [73]. The authors of [73] made a colloidal crystal array (CCA) or an opal photonic crystal, which strongly diffracts light, using highly charged mono-disperse polystyrene spheres. ...

Societal needs have driven the requirement for energy storage and conversion technologies that are cheap, stable, efficient and adaptable to a range of technology types ...

Armstrong, E. & O'Dwyer, C. Artificial opal photonic crystals and inverse opal structures-fundamentals and applications from optics to energy storage. J. Mater.

Hydrophobic fluorinated colloidal photonic crystals for heterogeneous aggregated cluster encoding and energy-saving applications. Author links open overlay panel Tong-Bo Chen ... anticounterfeiting and information storage, as well as the energy-saving optoelectronic devices. Graphical abstract. Download: Download high-res image (115KB) Download ...

One photon from an energy-time entangled pair⁵ is mapped onto the crystal and then released into a well-defined spatial mode after a predetermined storage time.

Energy Storage Materials and Sensors; Hierarchical Templating and Functionalization of Porous Catalysts and Catalyst Supports; ... Photonic crystals that exhibit photonic band gaps (PBG, a range of wavelengths that cannot be transmitted through the material) have foreseeable applications as waveguides, microcavity lasers, or inhibitors of light ...

(Photonic Crystal)1987S.JohnE.Yablonovitch,?, ...

Color-Coded Batteries - Electro-Photonic Inverse Opal Materials for Enhanced Electrochemical Energy Storage and Optically Encoded Diagnostics. Colm O'Dwyer, Corresponding Author. Colm O'Dwyer. ... By ...

2D and 3D photonic crystal materials for photocatalysis and electrochemical energy storage and Science and Technology of Advanced Materials (IF 7.4) Pub Date : 2016-09-16 Gillian Collins, Eileen Armstrong, David McNulty, Sally ...

Three-dimensional photonic crystals made of close-packed polymethylmethacrylate (PMMA) spheres or air spheres in silica, titania and ceria matrices have been fabricated and characterized using SEM, XRD, Raman spectroscopy and UV-Vis transmittance measurements. ... [25], although the energy difference is small. Valuable ...

When light is incident on a periodic structure, it gets reflected from each interface. These reflected waves, under suitable conditions, interfere constructively according to the well-known Bragg condition, modified for the photonic crystals, as given by [26] $m\lambda = 2n_{\text{eff}}d$ where m is the diffraction order, λ the wavelength of the reflected light, n_{eff} the effective ...

Reversible optical regulation has potential applications in optical anti-counterfeiting, storage, and catalysis. Compared to common power materials, the reverse opal structure has a larger specific surface area and an increased ...

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Details on all-optical probing methods for electrochemical energy storage materials, where the vision for correlating the fundamental physics of opal photonic crystals, and many attributes of ...

In this study, we revisit photocurable dispersions to achieve superior optical performance through volume fraction optimization and shear-assisted crystallization. We ...

A dual-functional photonic battery is proposed for dynamic radiative cooling, energy storage and recycling. ... (0.53 at 8-13 μm) and superior energy storage performance, ...

Researchers use phase-change materials to demonstrate an integrated optical memory with 13.4 pJ switching energy. Implementing on-chip non-volatile photonic memories has been a long-term, yet ...

The rapid development of flexible electronic devices has a great demand for flexible batteries with high energy density, safety, and stability [1], [2], [3], [4]. As the most commonly used energy storage device, lithium-ion batteries have severe obstacles to their further applications in flexible devices due to their safety risk and poor flexibility [5], [6], [7].

However, the energy storage density obtained was low ($< 1 \text{ J/cm}^3$), at high electric fields because the inhomogeneous microstructure created high electric field concentrations, degrading dielectric properties and causing inconsistent values of energy storage density. So, the crystal structure of BaTiO_3 was modified by adding SrO to form BST (Ba ...

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