Porous Photonic Crystals for Intraocular Drug Delivery

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BACKGROUND

The treatment of eye diseases, such as age-related macular degeneration, diabetic retinopathy, uveitis, and others, has been problematic. The largest barrier to effective treatment is the difficulty of delivering the appropriate concentration of drug to the correct location in the eye for a sufficient length of time. Various solutions have been attempted, including repeated intraocular injections of drug or surgical implantation of drug-permeated material. However, these methods are impractical and present a significant risk to the patient: multiple injections are required, each carrying a finite risk of infection, and surgical procedures are cumbersome and not always effective.

TECHNOLOGY DESCRIPTION

This invention presents two major advantages over existing ocular drug delivery technologies. First, the nanoporous silicon, or a biopolymeric cast of it, can be tailor-made for each type of drug to control the kinetics of sustained drug release such that the drug can be delivered in the eye with the optimal spatio-temporal profile over a long period of time. Further, several drugs can be delivered simultaneously, each with its own release parameters. Second, this customized nanomaterial has optical properties that allow a person to monitor drug levels in the implant without invasive procedures to the eye. The optical properties of this material change in a reproducible fashion as the concentration of drug decreases within the implant, so that one can view the implant through the iris to determine the amount of drug remaining. These properties make this an ideal material for drug delivery and non-invasive reporting of drug levels.

ADVANTAGES

- The use of this nano-material minimizes the number of injections required, reducing cost, scarring, and the likelihood of infection. It ensures that the patient receives an effective dose throughout the treatment period.
- Pore size, spacing, and layering can be controlled, and the surface chemistry of the nanoporous silicon or its biopolymeric equivalent can be modified to accommodate almost any type of compound. Furthermore, the optical properties of the material can be customized such that each drug can have its own optical signature, thus allowing one to monitor several drugs simultaneously.
- Porous silicon is biocompatible and bioresorbable, and has tunable pore volumes and a high surface area, so that its drug loading capacity is high.

STATE OF DEVELOPMENT

Nanoporous silicon has been implanted into the eye and its spectrum visualized through the iris for four months or longer with no obvious toxicity. Nanomaterial has been customized to release dexamethasone into solution. See related materials for other details.

RELATED MATERIALS

- Polymer Replicas of Photonic Porous Silicon for Sensing and Drug Delivery Applications (2003), Science v. 299, 2045-2047.
- Engineering the Chemistry and Nanostructure of Porous Silicon Fabry-Perot Films for Loading and Release of a Steroid (2004), Langmuir, v. 20(25), 11264-11269.
- http://chem-faculty.ucsd.edu/sailor/research

INTELLECTUAL PROPERTY INFO

This invention is available for licensing or sponsored research.

PATENT STATUS

Country	Type	Number	Dated	Case

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OTHER INFORMATION

KEYWORDS

drug delivery, vision, nanotechnology, porous silicon, bioengineering

CATEGORIZED AS

- **Medical**
  - Delivery Systems
  - Disease: Ophthalmology and Optometry
- **Nanotechnology**
  - NanoBio

RELATED CASES

2005-088-0

United States Of America	Issued Patent	9,937,129	04/10/2018	2005-088
United States Of America	Issued Patent	9,241,906	01/26/2016	2005-088
United States Of America	Issued Patent	8,945,602	02/03/2015	2005-088
United States Of America	Published Application	20180055765	03/01/2018	2005-088
United States Of America	Published Application	20100196435	08/05/2010	2005-088

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