Precision nanomedicine: Shaping cellulose nanocrystals

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STATUS PATENT: filed

N° PRIORITY: 102022000011450

GRANTED: -

PATENT FAMILY: PCT AVAILABLE

The invention

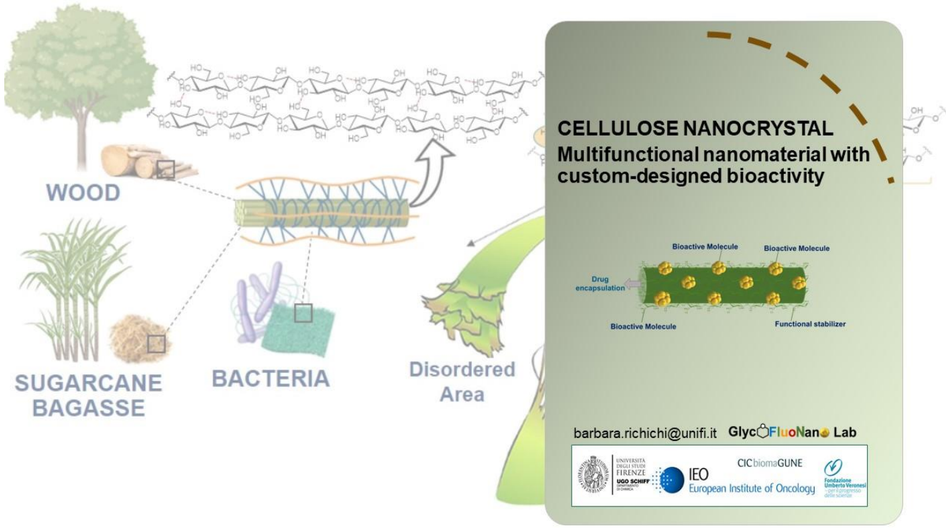
The invention consists of a smart, inexpensive and biocompatible **nanomaterial with custom-designed bioactivity**. It consists of cellulose nanocrystals (CNC) and is produced from renewable sources and waste.

The CNC is custom (*ad hoc*) modified by exploiting an environmentally friendly and scalable manufacturing process to be suitable for **precision nanomedicine applications**. With these nanoparticles customized for precision medicine, the ability of nanotechnology to target specific cells/tissues can be improved. The innovation is therefore of great interest to nanomedicine companies: this area of research involves attaching drugs to nanoparticles to increase their specific localization, thus allowing the associated drugs to reach the site of disease while avoiding healthy cells. Despite enormous advances in the field, there are very few nanomedicines that successfully use nanotechnology in this way.

The patented technology addresses this challenge by using a safe nanotechnology-based drug. The nanomaterial can be custom-modified to function effectively as a "**Trojan horse**," ensuring localization of the disease. The drug developed on the basis of the patented technology is also easily accessible: the manufacturing processes of nanomedicines are often more complicated than standard drug compounds. This may limit the ability of pharmaceutical companies to produce large quantities of nanomedicines. Our **manufacturing process** is robust, reliable, scalable, environmentally friendly, and provides the engineered bioactive molecule nanomaterial with high batch-to-batch reproducibility. **Modularity ensures multifunctionality**: our nanomaterial has a modular structure whose composition can be tailored by including multiple components to be suitable for the specific application in precision nanomedicine.

The patented nanomaterial has the potential to be formulated in different ways such as dispersion, gel, thin film, thus exploiting different routes of drug delivery: topical, parenteral, intravenous, intramuscular, subcutaneous.

Images


WOOD
SUGARCANE BAGASSE
BACTERIA
Disordered Area
CELLULOSE NANOCRYSTAL
Multifunctional nanomaterial with custom-designed bioactivity
Bioactive Molecule
Bioactive Molecule
Drug encapsulation
Bioactive Molecule
Functional stabilizer
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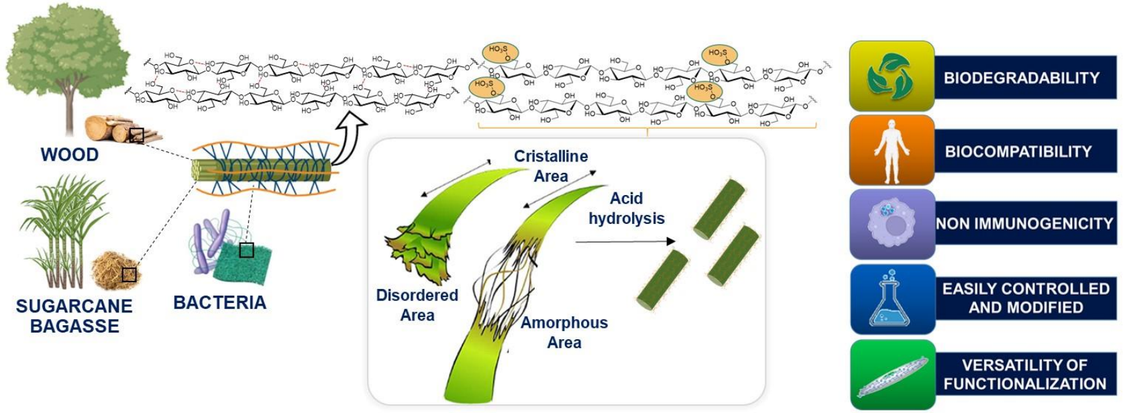
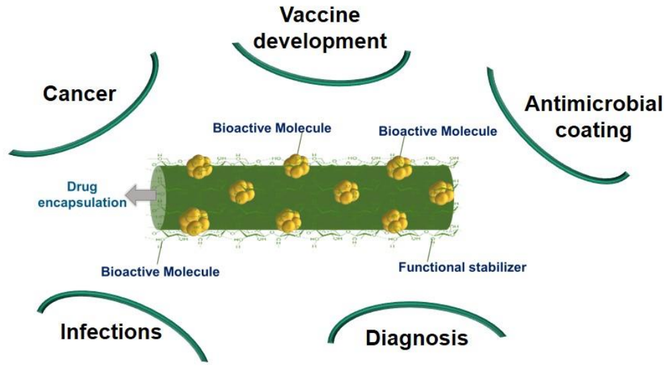

WOOD
SUGARCANE BAGASSE
BACTERIA
Cristalline Area
Acid hydrolysis
Disordered Area
Amorphous Area
BIODEGRADABILITY
BIOCOMPATIBILITY
NON IMMUNOGENICITY
EASILY CONTROLLED AND MODIFIED
VERSATILITY OF FUNCTIONALIZATION


Vaccine development
Cancer
Antimicrobial coating
Bioactive Molecule
Bioactive Molecule
Drug encapsulation
Bioactive Molecule
Functional stabilizer
Infections
Diagnosis

Industrial application

The potential applications of the patented technology are many, among the most relevant are all of the following:

1. **Cancer therapy**: radiotherapy, immunotherapy, boron neutron therapy, drug delivery;
2. **Infection prevention**: vaccine, multi-surface antimicrobial coating;
3. **Diagnosis**: diagnostic tool for bio-imaging applications on cells and in vivo.

At the same time, the patented technology ensures the following benefits:

1. Biocompatible and cost-effective nanomaterial produced from renewable sources and waste
2. Customized nanoparticles for precision nanomedicine
3. Efficient drug delivery
4. Robust and environmentally friendly manufacturing process
5. High batch-to-batch reproducibility
6. Multifunctionality.

Future developments

The technology maturity of the patent can be schematized as follows:

1. The nanomaterial has a significant effect in biological tests related to radiotherapy treatment of **cancer** (TRL 3);
2. The nanomaterial is accessible by exploiting a scalable and green **manufacturing process with high batch-to-batch reproducibility** (TRL 4)

Research activities are currently underway for:

1. The development of vaccines against cancer and infections
2. The development of diagnostic probes for cancer diagnosis
3. The development of nanomaterials responsive to external stimuli for cancer treatment

The inventors are considering both licensing the patent and creating a spin-off focused on the development of customized nanomaterials for biomedical and industrial applications, taking advantage of the possible benefit of knowing under exclusivity the methods and compositions to produce the protected nanomaterial.

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