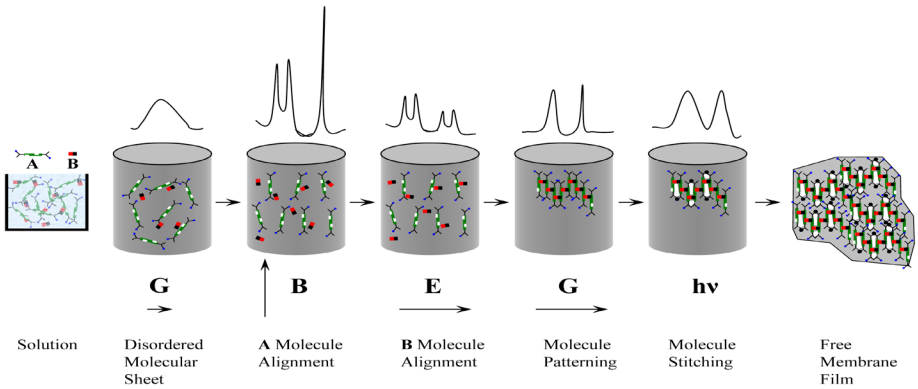
Technology Development
& Commercialization

Molecule Nanoweaver Creates High-Tech Medical Patches and Multilayered Capsules for Improved Drug Delivery and Treatment Efficacy

The ability to tailor medical patches and capsules at the molecular level offers a game-changing approach to medical treatment and drug delivery. With each molecule positioned for optimal effectiveness, patches and capsules can be improved and customized for a variety of purposes.



This figure illustrates a series of steps that make up the process of forming a film of nanoscale molecular assemblies.

Technology Description

Researchers at Argonne National Laboratory, led by Rex Gerald, have developed an extensive portfolio of patented technologies related to nuclear magnetic resonance (NMR).

In the medical field, NMR is best known for its use in magnetic resonance imaging (MRI). Historically, one of the major issues with the MRI scan has been its inability to operate with metal. Because of an incredibly strong magnetic field, patients with metal implants, pacemakers and other metallic objects cannot undergo an MRI.

Argonne's NMR portfolio is based on a unique design twist that turns this problem into a simple solution. Gerald and fellow researchers have manipulated MRI technology so that the problematic metal becomes the detection system, allowing it to go essentially unnoticed by the magnetic field. This enables the previously impossible capability to conduct NMR/MRI in situ analysis on film or membrane components of batteries and fuel cells, in real time under real test conditions. The innovation has led to many groundbreaking developments, including a spinoff called the Molecule Nanoweaver—a unique tool that can be used as both a detector and a fabricator of high-tech patches, multilayered capsules and other medical products.

As a fabricator, the Molecule Nanoweaver is able to produce these products by using electric, magnetic and intermolecular forces to manipulate molecules into useful patterns.

As a detector, the nanoweaver's NMR spectroscopy and imaging capabilities allow the user to follow the process

closely to ensure that fabrication is done correctly. For example, the Molecule Nanoweaver could be used to optimize and produce a heart muscle stimulator patch that provides low-level electrical stimulation from electrochemical reactions that take place in the patch material.

Potential Benefits

Because the Molecule Nanoweaver is such a game-changing technology, no obvious comparisons exist. But the advantages are easy to see when looking at the products the Nanoweaver can create.

As an example, today's medical patches are typically produced by using conventional fabrics or in some cases with spin coaters, which result in a generic process with no organizational control of the molecular ingredients.

The Molecule Nanoweaver gives the operator the power to control molecular orientation. This means the patch's molecular constituents can be carefully organized and positioned at exact locations for optimal functionality. The tool even has the ability to set up interactions between different molecules to attain unique medical functionalities. A purposeful molecular orientation can make it easier to achieve slow or sequential release of medications. The benefits provided by the Molecule Nanoweaver will ultimately lead to patches that are more efficient at delivering medication and treatment, which in turn can help speed up the entire healing process for patients.

A medical patch is just one example of a product that can be created by using the Argonne tool. The Molecule Nanoweaver can also make multilayered drug delivery capsules, bioengineered tissues, films and membranes. For all of these products, molecular orientation can lead to major improvements. Having control in the fabrication process will allow researchers to craft sophisticated patches that address more complex medical issues and target specific areas.

Technology Area: Medical Device
Product: A tool to fabricate and analyze medical patches
Development Stage: Proof of concept
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