Enzymatic Flow Reactor for Immobilized Enzyme Processes

metals · inorganics · organometallics · catalysts · ligands · custom synthesis · cGMP facilities · nanomaterials

Why Immobilized Enzyme Processes?

The advantages of biocatalysis are well recognized. These green and sustainable processes typically proceed under mild conditions, do not require the use of heavy or toxic metals, in many cases can be conducted in water and may replace the need for highly hazardous reagents. However, enzymes can be quite expensive. Immobilization provides for easy separation of the enzyme from the product so that it can be reused/recycled, thereby lowering the cost.

Why the Enzymatic Flow Reactor?

Strem Catalog No. 96-0900
Tube Reactor– with Nanospring coated support mesh

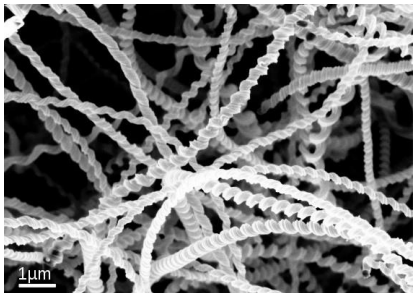
Strem Catalog No. 96-0900

While enzyme immobilization can provide numerous advantages, the commercial adoption of this technology has been somewhat limited due to the lack of availability of appropriate support materials. The chemical, biochemical, mechanical and kinetic properties of the immobilized enzyme are influenced by the interactions between the enzyme and the support. In addition, biocatalytic reactions run in batch processes using immobilized enzymes can experience inhibition due to saturation of the reaction solution.

In the **Enzymatic Flow Reactor**, enzymes are immobilized on the highly accessible surface area of functionalized silica Nanosprings™. The Nanosprings have a high surface area (>350 m2/g), and thus allow for a high density enzyme loading; because they are nonporous. However, they don't experience flow restriction or suffer from the diffusional limitations often associated with porous substrates. Furthermore, with the **Enzymatic Flow Reactor**, the product is removed continuously from the reaction mixture, so catalyst inhibition is not an issue. Furthermore, the enzyme remains stable in the reactor, so it can be reused multiple times.

What are NanoSprings™?

Silica Nanosprings™ are high surface area, one-dimensional nanomaterials made of amorphous silica that are produced using a proprietary atmospheric chemical vapor deposition process. They can be readily functionalized and coated onto a wide variety of substrates, including aluminum, polyimide, glass, silicon, stainless steel and carbon.



TEM image of Nanosprings

Visit www.strem.com for new product information and searchable catalog.

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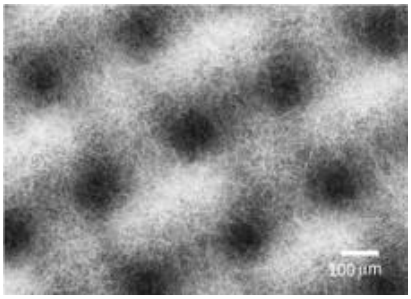
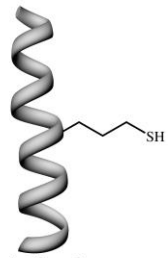
What is the Enzymatic Flow Reactor? Strem Catalog No. 96-0900



SEM image of Nanospring coated catalyst on support mesh

The Nanospring™ **Enzymatic Flow Reactor** is a 2.5 inch long, 0.25 inch i.d. tube that is packed with stainless steel mesh coated with a total of approximately 50 mg of silica Nanosprings.

The surfaces of these Nanosprings are functionalized with free sulfhydryl groups at the end of a three carbon chain that can react with an appropriately activated enzyme.

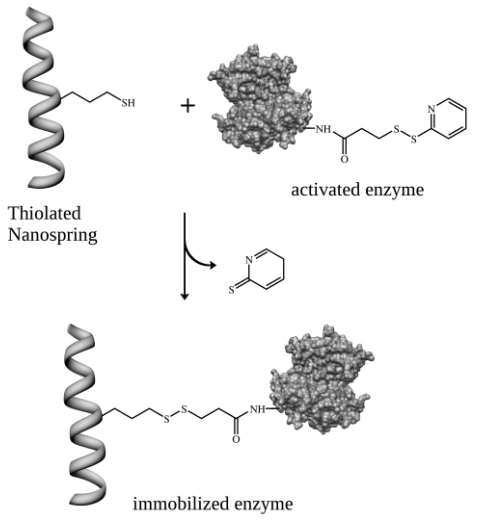


thiolated Nanospring

The maximum theoretical capacity of the **Enzymatic Flow Reactor** is 1 mg enzyme / 1 mg Nanosprings for average enzymes. Loading up to 40% of theoretical maximum has been observed.

Using the Enzymatic Flow Reactor

The **Enzymatic Flow Reactor** comes ready for enzyme immobilization. The first step is to incubate the desired enzyme with, for example, N-succinimidyl 3-(2-pyridyldithio)propionate (SPDP), which is a crosslinking agent that reacts with the free amino groups on the enzyme surface. A solution of the SPDP-modified enzyme is then slowly pumped through the reactor, during which time the thiolate groups on the Nanosprings react with the crosslinker on the enzyme to yield a covalently bound enzyme on the Nanospring surface.



Attachment of modified enzyme to Nanosprings

Key Features of the NanoSprings™ Enzymatic Flow Reactor

- Controllable processing for biocatalysis
- Continuous flow configuration
- No need for large capital expenditures or specialized equipment
- Can be connected in series for multi-step synthesis
- Can be functionalized for immobilization of enzymes, DNA, cells or proteins
- High density enzyme loading with increased stability due to silica Nanosprings support
- Easy and continuous separation of the product from the reaction mixture avoids inhibition
- Strong enzyme attachment eliminates need for recovery
- Reactor can be reused multiple times

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