Digital Microfluidic Platform for Radiochemistry

Tech ID: 21509 / UC Case 2010-247-0

SUMMARY

UCLA researchers have created a novel, integrated microfluidic approach to radiochemical synthesis. Radiochemicals have been successfully synthesized on droplet-based microfluidic chips operated by electro-wetting-on-dielectric (EWOD) actuation.

BACKGROUND

Radiochemicals have important uses in medicine, preclinical research, biology, biochemistry, and environmental science. Radiochemical synthesis requires rapid reactions and purification steps, protective radiation shielding, and specialized equipment. Currently, the usual synthesis approach is to use macroscopic batch systems. However, such systems are expensive, large (requiring bulky, expensive radiation shielding), and use volumes that are larger than necessary. Microfluidic devices possess properties that can reduce these disadvantages. Continuous flow microfluidic devices can perform reactions at high speeds but require several external pieces of equipment, such as pumping systems, which increase size and expense. Fully-integrated microfluidic devices do exist, but typically are not compatible with all liquids, such as organic solvents. Further, such integrated approaches are not yet able to reliably synthesize many radiochemicals. Thus, there is a need for an integrated, cost-effective, highly reliable microfluidic device that allows for precise control of radiochemical reactions.

INNOVATION

UCLA researchers have created a novel, integrated microfluidic approach to radiochemical synthesis. The device uses electro-wetting-on-dielectric (EWOD) microfluidic technology to control the flow of reagent droplets. The droplets movements are precisely controlled by electric fields, using voltages typically below 100 volts. Since the device uses an array of electrodes to control droplet movements, a variety of pathways (and reaction processes) can be created simply by altering the software. The device and array of pathways are made of inert substances that are highly compatibility with a broad range of temperatures and chemicals. Included on the device itself is a heating element able to induce the chemical reactions required for radiochemical synthesis.

APPLICATIONS

- Synthesize radiochemicals with precise control of reactions
- Prepare diverse radiochemicals with only reagent and software changes
- Control the movement of individual droplets, including splitting, mixing, and size-selection of droplets to perform chemical reactions

ADVANTAGES

- Inert surface compatible with wide variety of liquids
- Device can be fabricated by standard, reliable techniques
- Integrated approach that reduces size and cost of necessary equipment
- Ability to create flexible fluid paths
- Ability to precisely control individuals droplets, serving as 'microreactors' for radiochemical synthesis
- Uses open fluid pathways, speeding up chemical mixing and evaporation of solvents
- Thermally stable

STATE OF DEVELOPMENT

CONTACT

UCLA Technology Development Group
ncd@tdg.ucla.edu
tel: 310.794.0558.



INVENTORS

- van Dam, Michael

OTHER INFORMATION

KEYWORDS

radiochemistry, microfluidic, droplets, positron emission tomography, PET, EWOD, electrowetting, digital microfluidics

CATEGORIZED AS

- Engineering
  - Other

RELATED CASES

2010-247-0

UCLA researchers have developed the EWOD chip and successfully controlled droplet movement of a variety of liquids typically used in radiochemical synthesis. Further, researchers have used the device to successfully carry out a full synthesis of radioactive 1-[^{18}F]fluoro-4-nitrobenzene, and 2-[^{18}F]fluoro-2-deoxy-D-glucose, commonly used by the medical and preclinical research fields in positron emission tomography applications.

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	9,005,544	04/14/2015	2010-247

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Device and Method for Microscale Chemical Reactions
- Microscale Device and Method for Purification of Radiopharmaceuticals

UCLA Technology Development Group
10889 Wilshire Blvd., Suite 920,Los Angeles,CA 90095
https://tdg.ucla.edu
Tel: 310.794.0558 | Fax: 310.794.0638 | ncd@tdg.ucla.edu

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