Pressure Driven Flow Control in Microreactor Systems
Technology #12370

Applications

The microscale inline pumping technology described in this invention can be used to develop microchemical systems for drug discovery, research and development, as well as optimization and production in the specialty chemical and pharmaceutical industries.

Problem Addressed

Significant advances have been made in the design and fabrication of microreactors for use in lab-on-a-chip or plant-on-a-chip applications. However, less progress has been made in the fluidic and pumping technology used to move reactants into and out of microreactors. This has resulted in the overall performance of microchemical systems being limited by fluidic and pumping technology. Existing microfabricated valves and pumps are incompatible with harsh chemistries, limited to low flow rates and volumes, and produce fluctuating flows. Macroscale syringe pumps are capable of fluctuation-free flow, but impose a uniform flow rate across all connected devices, limiting their utility in microchemical systems where different flow rates are required. This invention describes a novel inline pumping technology that overcomes these limitations.

Technology

This invention describes an intermediate pump that can be placed between two microreactors to control the flow rate and/or pressure of fluid between them. The pump comprises two fluid enclosures which provide two parallel flow paths between the pump inlet and outlet. When the pump is used to transport a liquid payload, each of the two enclosures is partially filled by the payload fluid. During operation, a gaseous pressurizing fluid is introduced into the headspace above the payload to increase the pressure in a particular enclosure, thereby driving the flow of payload through the outlet. Subsequently, the flow of pressurizing fluid is redirected into the other enclosure while payload fluid continues to flow under residual pressure. By careful control of the flow of pressurizing fluid, the net flow rate from across the pump (i.e., the sum of flow rates through each of the two enclosures) can be maintained at a constant level, enabling non-fluctuating flow. The pump can be constructed at the macroscopic scale using glassware or microfabricated from silicon, enabling a wide range of flow rates ranging from nanoliters to milliliters per second to be achieved. Additionally, the use of inert construction materials allows the pump to be used to transport a wide range of fluids, including harsh chemistries that degrade exiting elastomer-based microfabricated pumps.

Advantages

- Can be used as intermediate pumps, allowing different flow rates to different devices in microchemical systems
- Glass and/or silicon construction is safe to use with a wide range of chemistries
- Generates fluctuation-free flows across a wide range of flow rates (nL/s - mL/s)
Categories For This Invention:

Chemicals
Mechanics
Life Sciences
Research Tools
Micro/nanoparticles (Research Tools)

Intellectual Property:

Pumping and flow control in systems including microfluidic systems
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