

Selective rf wireless control of integrated bulk-micromachined shape-memory-alloy actuators and its microfluidic application

Abstract

This paper reports wireless microfluidic control enabled by selective operation of multiple bulk-micromachined shape-memory-alloy actuators using radiofrequency external magnetic fields. Each shape-memory-alloy actuator is driven by a wireless resonant heater, which generates heat only when the field frequency is tuned to the resonant frequency of the heater. Multiple actuators coupled with the heater circuits that are designed to have different resonant frequencies in a range of 135-295 MHz are selectively controlled by modulating the field frequency to the resonant frequencies of the corresponding heaters with a constant output power. A wireless microsyringe device that has three actuator-heater components and a flexible parylene reservoir is developed. The 5- μ l reservoir is squeezed by the 5-mm-long cantilever-type SMA actuators to eject controlled amounts of liquid from the reservoir. Wireless modification of pH in liquid is demonstrated using the device loaded with acidic solution through the selective control of the three actuators based on the frequency modulation technique.