joined by a passage and a thermally responsive substance (TRS) disposed to substantially obstruct the passage, wherein a length of the TRS obstructing the passage is greater than a width of the upstream channel adjacent the passage. A heat source is in thermal contact with the TRS, wherein, upon actuation of the heat source, an opening motion of the TRS opens the passage.

[0016] Another embodiment of the invention relates to a valve for use in a microfluidic system, comprising a substrate defining a first and second channel joined by a passage, the first channel and the passage defining an opening therebetween, a thermally responsive substance (TRS) disposed to substantially obstruct the passage, wherein a height of opening is less than a height of the first channel adjacent the opening such that capillary action draws TRS into the passage and a surface tension of the TRS substantially prevents the TRS from entering the first or second channel, and a heat source in thermal contact with the TRS, wherein, upon actuation of the heat source, an opening motion of the TRS opens the passage.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] The present invention is described below in reference to the following drawings, in which:

[0018] **FIG. 1** shows a microfluidic system according to the invention;

[0019] **FIG. 2***a* shows a closed state of a valve of the invention;

[0020] **FIG. 2***b* shows an open state of the valve of **FIG. 1***a;*

[0021] **FIG. 3***a* shows a perspective cross sectional view of the valve of claim la;

[0022] **FIG. 3***b* shows a cross sectional view taken along section **3***b* of **FIG. 3***a;*

[0023] **FIG. 4***a* shows a closed state of another valve of the invention;

[0024] **FIG. 4***b* shows an open state of the valve of **FIG. 3***a;*

[0025] **FIG. 5***a* shows a closed state of another valve of the invention;

[0026] **FIG. 5***b* shows an open state of the valve of **FIG. 4***a;*

[0027] **FIG. 6***a* shows a closed state of another valve of the invention;

[0028] **FIG. 6***b* shows an open state of the valve of **FIG. 5***a;*

[0029] **FIG. 7***a* shows a closed state of another valve of the invention;

[0030] **FIG. 7***b* shows an open state of the valve of **FIG. 6***a;*

[0031] **FIG. 8***a* shows a closed state of another valve of the invention;

[0032] **FIG. 8***b* shows an open state of the valve of **FIG. 7***a;*

[0033] **FIG. 9***a* shows a closed state of another valve of the invention;

[0034] **FIG. 9***b* shows an open state of the valve of **FIG. 8***a;*

[0035] **FIG. 10***a* shows a closed state of another valve of the invention;

[0036] **FIG. 10***b* shows an open state of the valve of **FIG. 9***a;*

[0037] **FIG. 11***a* shows a top view of another valve of the invention;

[0038] **FIG. 11***b* shows a side view of the valve of **FIG. 10***a;*

[0039] **FIGS. 11***c* and **11***d* show a perspective, cut-away view of the valve of **FIG. 10***a;*

[0040] **FIGS. 12***a*-**12***c* show top views of a capillary assisted loading valve of the invention;

[0041] **FIGS. 13***a*-**13***d* show photolithigraphic masks suitable for fabricating a system according to the invention;

DETAILED DESCRIPTION OF THE INVENTION

[0042] The present invention relates to improved valves for microfluidic systems and microfluidic systems comprising the improved valves. Referring to **FIG. 1, a** microfluidic system **700** of the invention is configured to perform analyses using minute amounts of material, such as samples and reagents, which can be transported among different regions of the system. The different regions include, for example, chambers, channels and passages, as discussed below. An important feature of microfluidic system **700** is the capability of regulating the passage of material between its different regions. For example, system **700** includes a valve **706**, which regulates the passage of material between a material introduction channel **702** and a chamber **704**. When valve **706** is open, material can be introduced into chamber **704** for processing, such as by concentrating, diluting, mixing, or reacting the material. Once a desired amount of material has been introduced, valve **706** can be closed to substantially prevent additional material from entering along channel **702**. Valve **706** operates as a multi-use valve, which can be toggled between the opened and closed states without loss of performance.

[0043] An embodiment of such a multi-use valve **50** is shown in **FIGS. 2***a* and **2***b*. Valve **50** regulates the passage of material between a first channel **52** and a second channel **54**. A valve passage **68** connects the channels through the valve. In the open state, **FIG. 2***b,* TRS **56** is retracted into a valve reservoir **55** to allow the passage of material from one channel to the other. In the closed state, **FIG. 2***a,* a mass of temperature responsive material (TRS) **56** substantially obstructs passage **68**. The closed valve substantially prevents the passage of material between channels **52**, **54**.

[0044] The valve opening operation preferably includes actuating a heat source **37** to heat TRS **56** thereby modifying a physical or chemical property thereof, such as by making TRS **56** softer. A cooler **36** cools a gas **34** trapped in contact with an end **30** of TRS **56**. The resulting contraction of gas **32** decreases the pressure acting upon end **30** and retracts the softened TRS **56** into reservoir **55**. To close valve **50**, gas **32**