(12) UK Patent Application (19) GB (11) 2 400 678 (13) A

(43) Date of A Publication 20.10.2004

(21) Application No: 0407168.4

(22) Date of Filing: 30.03.2004

(30) Priority Data:
(31) 10412859 (32) 14.04.2003 (33) US

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(51) INT CL[7]:
G02B 6/35

(52) UK CL (Edition W):
G2J JGEE

(56) Documents Cited:
GB 2381595 A

(58) Field of Search:
UK CL (Edition W) **G2J**
INT CL[7] **G02B**
Other: **Online: WPI, EPODOC, JAPIO, TXTE**

(54) Abstract Title: **Polymeric optical switch using liquid metal**

(57) A polymeric optical switch in which a switching channel (106) is formed in a polymer layer (104). The channel (106) maybe formed by a micro-machining technique such as laser ablation or photo-imaging. A liquid metal switch is contained within the switching channel. The liquid metal switch operates by blocking or unblocking the optical path through the switching channel using a volume of liquid metal (506 and 508). Contact pads (502, 130 and 504) within the switching channel are wettable by the liquid metal eg mercury and provide a latching mechanism for the switch. The polymer layer (104) may be located between two transparent switch substrates (102 and 120). Solder rings (114, 126) are attached to the perimeters of the transparent switch substrates. The solder rings (114, 126) are wettable by solder (128) and facilitate the creation of a hermetic seal between the substrates (102, 120). Optical connectors (110, 124) allow optical signals to be coupled through the transparent layers and the switching channel. Optic fibres 108,122, 310, 314 are shown. Heaters (304, 702, Fig 7) may be present in the switch.

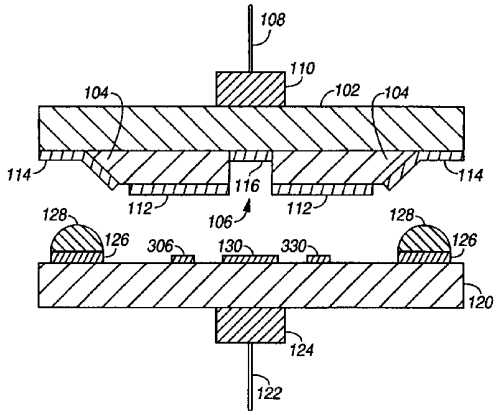


FIG. 1

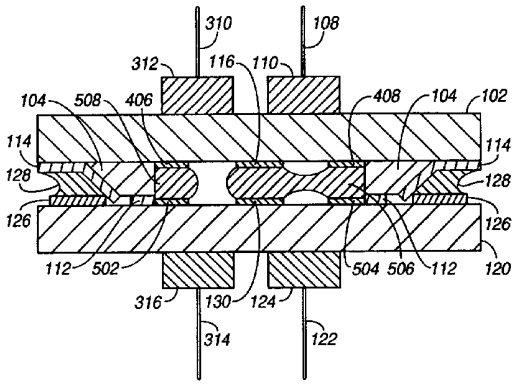


FIG. 5

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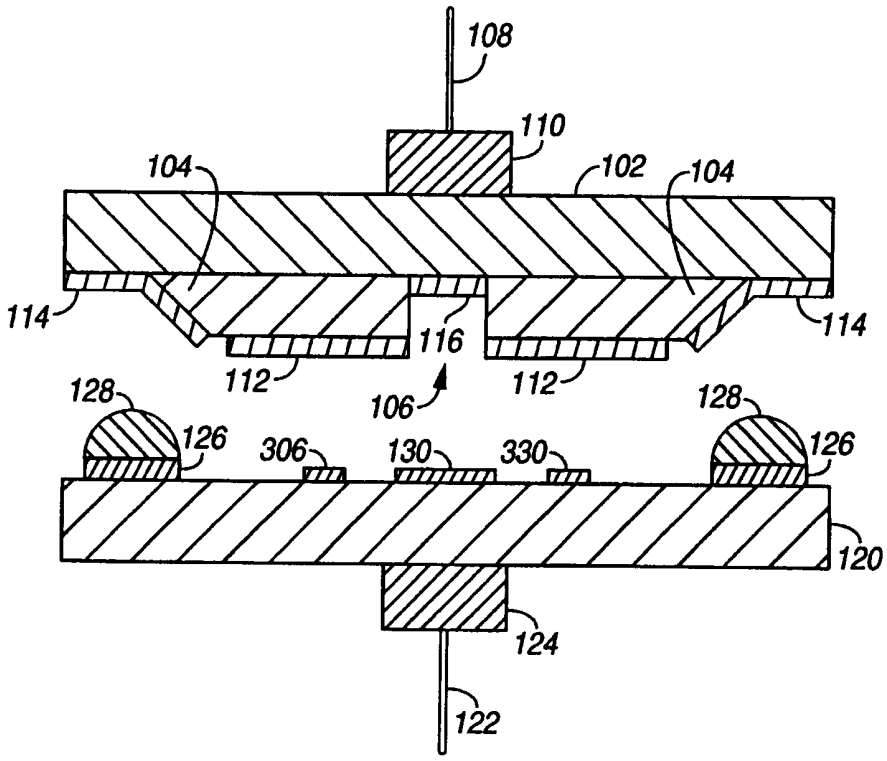

108
110
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124
122

FIG. 1

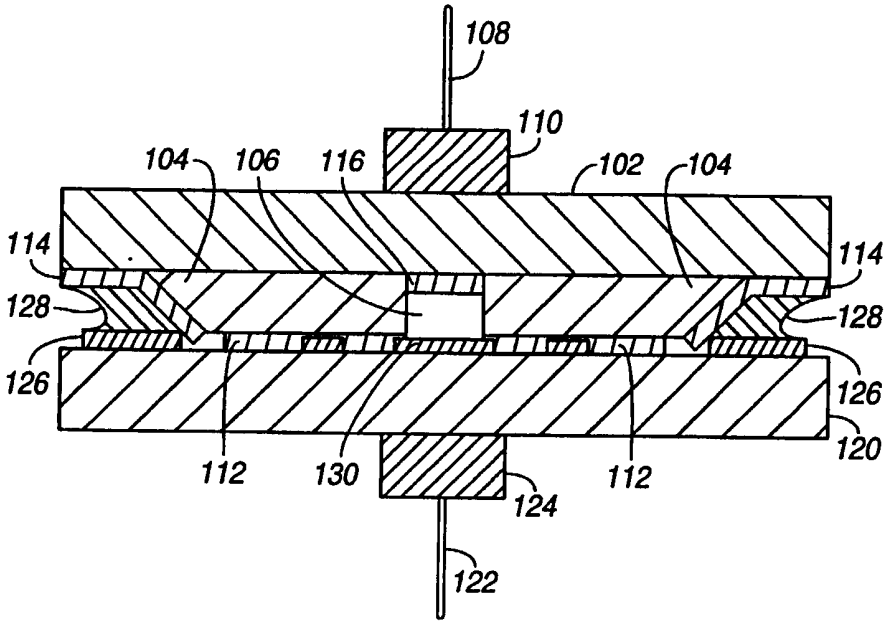

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FIG. 2

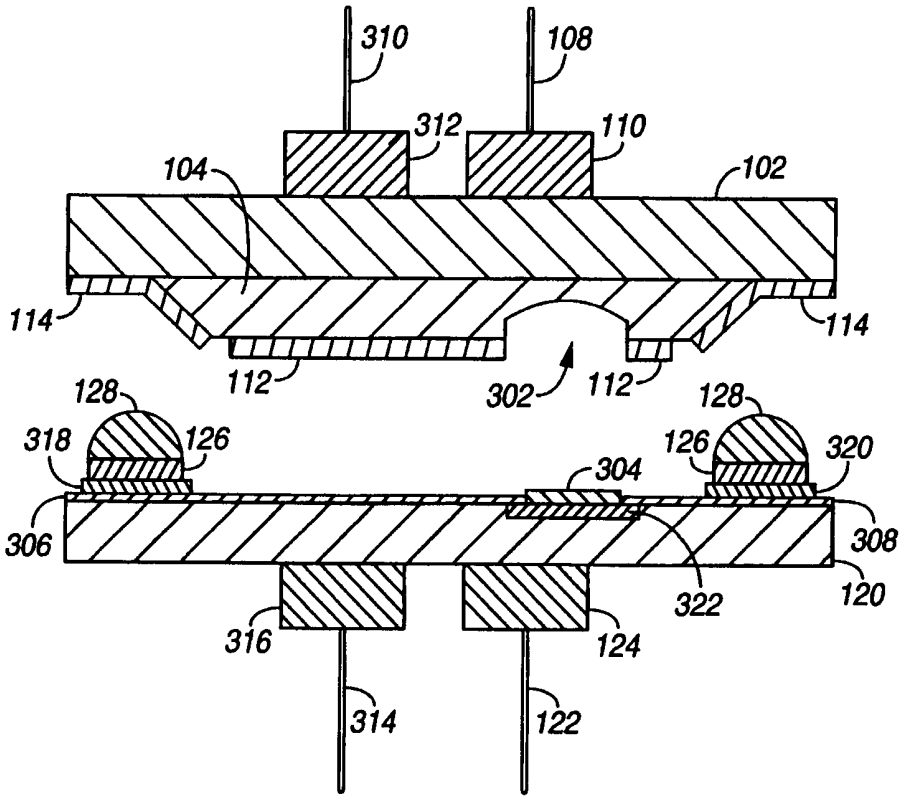

310
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312
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FIG. 3

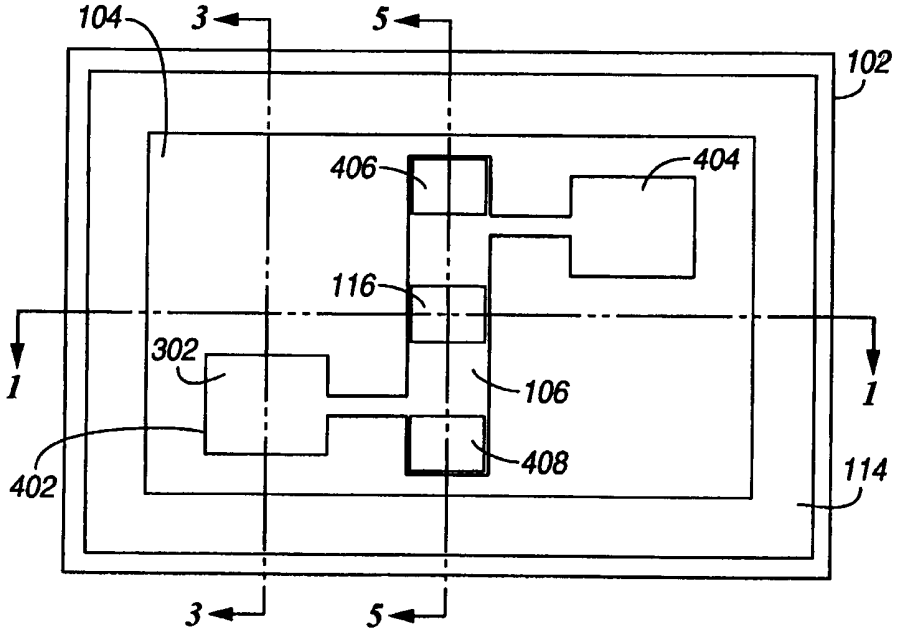

104
3
5
102
406
404
116
302
106
1
1
402
408
114
3
5

FIG. 4

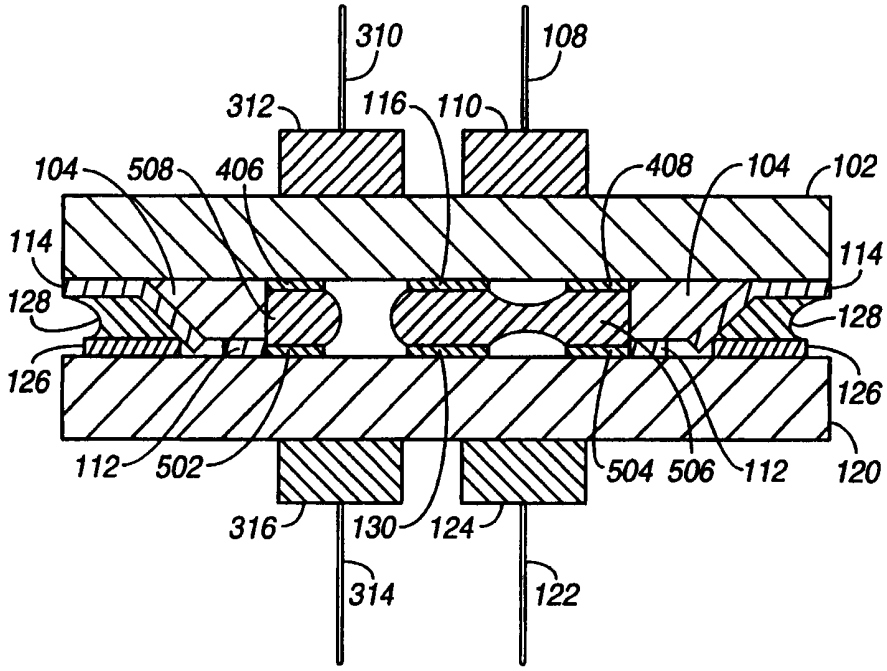

310
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314
122

FIG. 5

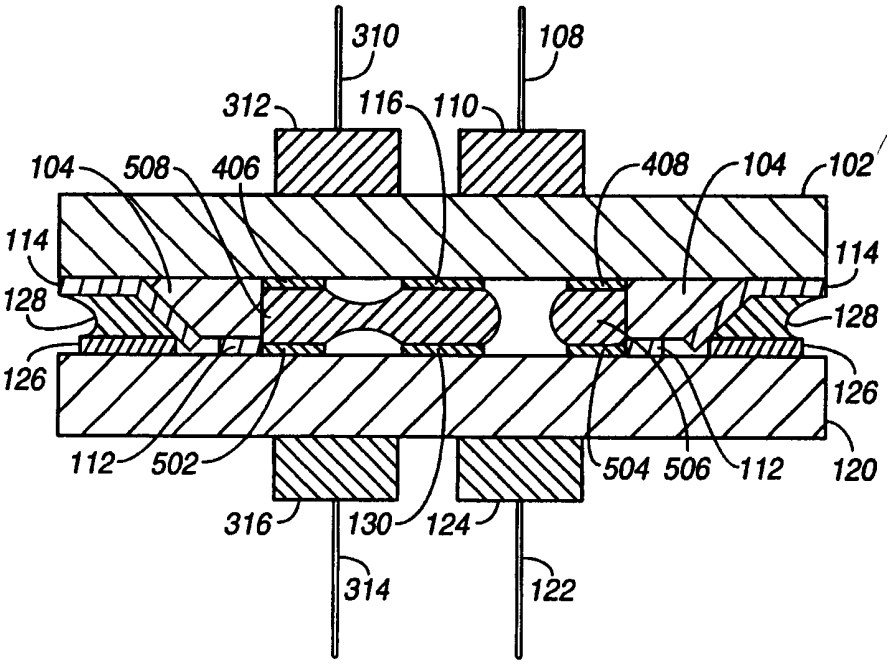

310
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504
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316
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314
122

FIG. 6

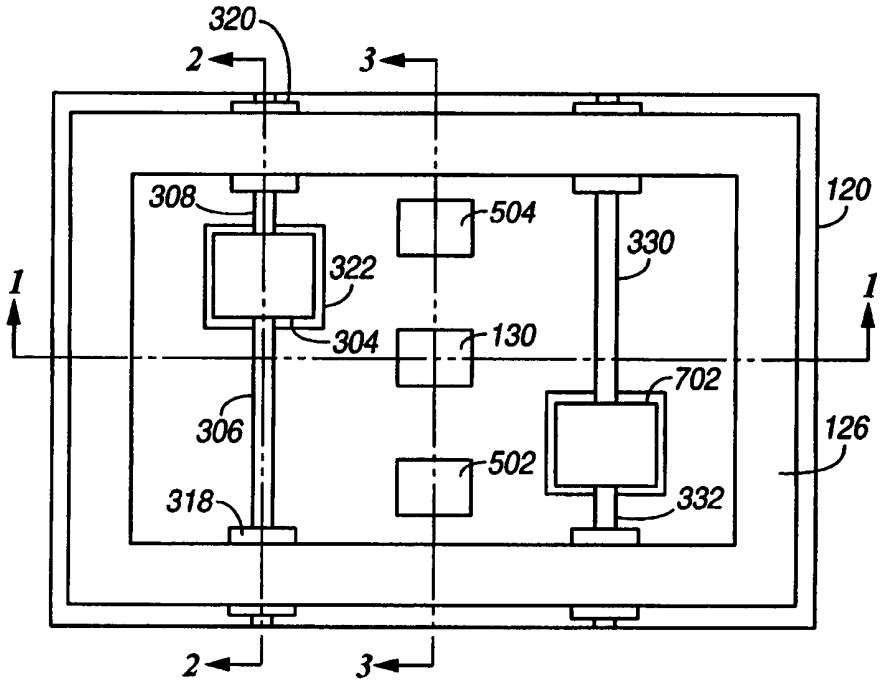

320
2
3
120
308
504
330
322
1
1
304
130
702
306
126
502
318
332
2
3

FIG. 7

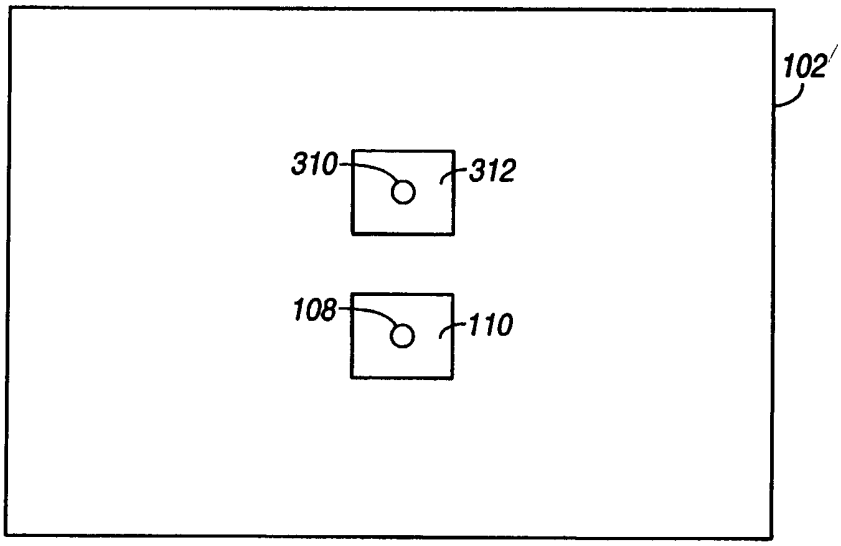

102'
310
312
108
110

FIG. 8

OPTICAL SWITCH

This application is related to the following co-pending Patent Applications, being identified by the below enumerated identifiers, which have the same ownership as the present application and to that extent are related to the present application and which are hereby incorporated by reference:

"Piezoelectrically Activated Relay", filed 12 March 2003 and identified by Application Number 0305668.6;

"Latching Relay" (attorney ref. N14640) having the same filing date as the present application;

"Latching Relay" (attorney ref. N14639) having the same filing date as the present application;

"Piezoelectrically Actuated Relay", filed 7 March 2003 and identified by Application Number 0305286.7;

"Latching Relay" (attorney ref. N14638) having the same filing date as the present application.

"Latching Relay" (attorney ref. N14654) having the same filing date as the present application;

"Latching Relay" (attorney ref. N14663) having the same filing date as the present application;

"Latching Relay Array" (attorney ref. N14664) having the same filing date as the present application;

"Latching Relay Array" (attorney ref. N14677) having the same filing date as the present application;

"Optical Relay" (attorney ref. N14676) having the same filing date as the present application;

"Optical Latching Relay", filed 25 October 2002 and identified by Application Number 0224877.1;

"Switch" (attorney ref. N14681) having the same filing date as the present application;

"Switch" (attorney ref. N14684) having the same filing date as the present application;

"Latching Relay" (attorney ref. N14685) having the same filing date as the present application;

"Method and Structure for a Switch" (attorney ref. N14689) having the same filing date as the present application;

"Method and Structure for an Optical Switch" (attorney ref. N14688) having the same filing date as the present application;

"Switch and Production Thereof", filed 9 December 2003 and identified by Application Number 0328557.4;

"Latching Relay" (attorney ref. N14716) having the same filing date as the present application;

"Latching Relay" (attorney ref. N14720) having the same filing date as the present application;

"Latching Relay" (attorney ref. N14727) having the same filing date as the present application;

"Latching Relay" (attorney ref. N14725) having the same filing date as the present application;

"Piezoelectric Pump" (attorney ref. N14726) having the same filing date as the present application;

"Solid Slug Longitudinal Piezoelectric Latching Relay", filed in the US on May 2, 2002 and identified by Serial Number 10,137,692;

"Method and Structure for a Switch" (attorney ref. N14816) having the same filing date as the present application;

"Method and Structure for an Optical Switch" (attorney ref. N14815) having the same filing date as the present application;

"Method and Structure for a Slug Assisted Pusher-Mode Piezoelectrically Actuated Liquid Metal Optical Switch" filed in the US on 14 April 2004 (attorney ref. 10011397-1);

"Switch" (attorney ref. N14824) having the same filing date as the present application;

"Optical Relay" (attorney ref. N14823) having the same filing date as the present application;

"Latching Relay" (attorney ref. N14821) having the same filing date as the present application;

"Damped Longitudinal Mode Optical Latching Relay" which was filed in the US on 14 April 2003 (attorney ref. 10011458-1);

"Damped Longitudinal Mode Latching Relay" which was filed in the US on 14 April 2003 (attorney ref. 10011459-1);

"Switch and Method for Producing the Same", filed in the US on December 12, 2002 and identified by Serial Number 10/317,963;

"Piezoelectric Optical Relay", filed in the US on March 28, 2002 and identified by Serial Number 10/109,309;

"Electrically Isolated Liquid Metal Micro-Switches for Integrally Shielded Microcircuits", filed in the US on October 8, 2002 and identified by Serial Number 10/266,872;

"Piezoelectric Optical Demultiplexing Switch", filed in the US on April 10, 2002 and identified by Serial Number 10/119,503;

"Volume Adjusting Apparatus and Method for Use", filed in the US on December 12, 2002 and identified by Serial Number 10/317,293;

"Method and Apparatus for Maintaining a Liquid Metal Switch in a Ready-to-Switch Condition", which was filed in the US on 14 April 2003 (attorney ref. 10020241-1);

"A Longitudinal Mode Solid Slug Optical Latching Relay" which was filed in the US on 14 April 2003 (attorney ref. 10020242-1);

"Reflecting Wedge Optical Wavelength Multiplexer/Demultiplexer" which was filed in the US on 14 April 2003 (attorney ref. 10020473-1);

"Method and Structure for a Solid Slug Caterpillar Piezoelectric Relay" which was filed in the US on 14 April 2003 (attorney ref. 10020540-1);

"Method and Structure for a Solid Slug Caterpillar Piezoelectric Optical Relay which was filed in the US on 14 April 2003 (attorney ref. 10020541-1);

"Inserting-finger Liquid Metal Relay" which was filed in the US on 14 April 2003 (attorney ref. 10030438-1);

"Wetting Finger Liquid Metal Latching Relay", which was filed in the US on 14 April 2003 (attorney ref. 10030440-1);

"Pressure Actuated Optical Latching Relay" which was filed in the US on 14 April 2003 (attorney ref. 10030521-1);

"Pressure Actuated Solid Slug Optical Latching Relay" which was filed in the US on 14 April 2003 (attorney ref. 10030522-1); and

"Method and Structure for a Slug Caterpillar Piezoelectric Reflective Optical Relay" which was filed in the US on 14 April 2003 (attorney ref. 10030546-1).

The invention relates to a polymeric optical switch in the field of micro-electromechanical system (MEMS) for optical switching, and in particular to a polymeric liquid metal optical switch.

Liquid metal switches have been devised that use the heating of gases to create pressure changes that actuate the switches by creating gaps in liquid metal drops trapped in channels (to unblock optical paths) and moving the drops to wet between contacts (to block optical paths). A current method used to manufacture the channel structures has resolution and accuracy limits because it uses sandblasting to form the channels. In addition, the way the heater resistors are currently formed on the ceramic substrate causes energy inefficiencies from heat loss into the ceramic substrate.

The present invention relates to a polymeric optical switch in which a switching channel is formed in a polymer layer. The channel may be formed by micro-machining techniques such as laser ablation or photo-imaging. A liquid metal switch is contained within the switching channel. The liquid metal switch operates by blocking or unblocking the optical path through the switching channel using a volume of liquid metal. Contact pads within the switching channel are wettable by the liquid metal and provide a latching mechanism for the switch. The polymer layer may be located between two transparent switch substrates.

The features of the invention believed to be novel are set forth with particularity in the appended claims. Preferred embodiments of the invention itself however, both as to organization and method of operation, together with objects and advantages thereof, may be best understood by reference to the following detailed description, which describes certain exemplary embodiments of the invention, taken in conjunction with the accompanying drawings in which:

FIG. 1 is a sectional view of a self-packaged, polymeric liquid metal optical switch in accordance with certain embodiments of the present invention.

FIG. 2 shows a sectional view of an assembled switch in accordance with certain embodiments of the present invention.

FIG. 3 shows a further sectional view of a polymeric liquid metal switch in accordance with certain embodiments of the present invention.

FIG. 4 is a view of the inner surface of a channel support plate in accordance with certain embodiments of the present invention.

FIG. 5 is a sectional view of an assembled polymeric optical switch in a first switch state.

FIG. 6 is a sectional view of an assembled polymeric optical switch in a second switch state.

FIG. 7 is a view of the inner surface of a switch substrate in accordance with certain embodiments of the present invention.

FIG. 8 is a view of the outer surface of a channel support plate in accordance with certain embodiments of the present invention.

While this invention is susceptible of embodiment in many different forms, there is shown in the drawings and will herein be described in detail one or more specific embodiments, with the understanding that the present disclosure is to be considered as exemplary of preferred embodiments of the invention and not intended to limit the invention to the specific embodiments shown and described. In the description below, like reference numerals are used to describe the same, similar or corresponding parts in the several views of the drawings.

such as laser ablation of polyimide or other polymeric films or layers, to create a channel structure in an optical liquid metal switch. This method achieves better tolerances and resolution than are achievable by sandblasting. In one embodiment, a channel layer is constructed out of Kapton (RTM) (a sheet form of polyimide) or some other suitable polymeric film by laser ablating the necessary channel features into it. The channel layer is then adhered to the switch substrate using a suitable adhesive, such as Cytop (RTM) or KJ (a thermoplastic polyimide with adhesive properties). Kapton is permeable to water vapor. If water vapor needs to be excluded from the resulting assembly, the assembly may be packaged for hermeticity, or it may be "self-packaged" by lamination to an impermeable support plate and sealed to the switch substrate using solder. The support plate may be made of metal, glass, silicon, or ceramic for example. The upper and lower support plates may be made of transparent

materials, e.g. glass or quartz, to allow the transmission of optical signals through them.

In a further embodiment, the polymeric channel layer is made by coating a support plate with a suitable liquid polymer (such as a spin-on polyimide), curing it, and then creating the desired channel structure by laser ablation. Alternatively, if the material is photo-imageable, the channel structure may be made by exposing and developing the necessary features before the material is cured. The resulting channel layer may have a layer of adhesive deposited on it by spin coating or spray coating, for example, and then photo-imaged or laser ablated. Cytop could be processed by the former process; KJ could be processed by the latter.

It is also desirable to eliminate the loss of heat from the resistors into the substrate as much as possible. This can be done by creating pockets in the surface of the switch substrate and filling them with a low thermal conductivity polymer such as polyimide before the resistors are deposited. The drive signals to the resistors may be conducted by vias through the switch substrate or by traces on top of or running through the switch substrate, for example.

In a further embodiment, loss of heat from the resistors to the substrate is reduced by using a polymer, such as polyimide, with low thermal conductivity and resistance to high temperature for the switch substrate. The resistors may be deposited directly onto the polyimide or onto intermediate layers as desired. Thinning of the polyimide under and near the heater region can be used to reduce thermal conduction and thermal capacitance in the heater area. However, this approach has the disadvantage of needing a separate package if hermeticity is desired.

FIG. 1 shows a sectional view of a self-packaged, polymeric liquid metal optical switch of an embodiment of the present invention. The switch in **FIG. 1** is shown in two parts before final assembly. The upper part includes a transparent channel support plate 102 covering a polymer layer 104. In other embodiments, opaque substrates containing waveguides may be used. The transparent channel support plate 102 may be made of glass or quartz, for example. The polymer may be polyimide, for example, which is an inert plastic, resistant to high temperatures. A switching channel 106 is formed in the polymer layer. An optical fiber 108 is coupled to the transparent channel support plate 102 by an optical connector 110. A layer of adhesive 112 covers the underside of the polymer layer 104. The adhesive may be Cytop or KJ, for example. Alternatively, the adhesive may be applied to the upper surface of the transparent switch substrate 120 of the lower part. In the preferred embodiment, the adhesive layer is approximately 7 microns thick. An upper solder ring 114 is attached to the perimeter of the underside of the transparent channel support plate 102 and the sides of the polymer layer 104. The upper solder ring is wettable by molten solder.

The lower part of the switch in **FIG. 1** includes a transparent switch substrate 120. The substrate may be made of glass or quartz for example. An optical fiber 122 is coupled to the transparent switch substrate 120 by an optical connector 124. A lower solder ring 126 is attached to the perimeter of the inner surface of the transparent switch substrate 120. The upper solder ring is wettable by molten solder 128. Wettable contact pads, such as that shown as 130, are also formed on the inner surface of the transparent switch substrate 120 and aligns with the channel 106 in the

upper part of the switch when the two parts are assembled. The wettable contact pad 130 is wettable by a liquid metal, such as mercury, which is used to provide a latching mechanism in the switch. In the preferred embodiment the contact is approximately 8000 Å thick. Electrical connectors 306 and 330 supply drive signals to heaters, which will be described below with reference to **FIG. 3**.

FIG. 2 shows a sectional view of the assembled switch. The adhesive layer 112 bonds the polymer layer 104 to the transparent switch substrate 120 and creates a cavity 106 within the switch. The contact pad 130 is positioned on one side of the cavity 106. The solder 128 is drawn by surface tension to fill the gap between the upper solder ring 114 and the lower solder ring 126. This provides a reliable hermetic seal for the interior of the switch. Provided there is sufficient solder, the wettable solder rings guarantee that the seal will be complete.

FIG. 3 shows a further sectional view of a polymeric switch of the present invention. The polymer layer 104 in the upper part contains a heater cavity 302. A heater 304, such as a resistor, is positioned on the inner surface of the transparent switch substrate 120 and is aligned with the heater cavity 302. When the two parts are assembled, the heater is inside the heater cavity. Electrical conductors 306 and 308 provide electrical connections to the heater. In operation, a voltage is applied across the heater and the gas in the heater cavity is heated, causing an increase in pressure and volume of the gas. Optionally, a second optical fiber 310 is coupled to the transparent channel support plate 102 via optical connector 312. A corresponding optical fiber 314 is coupled to the transparent switch substrate 120 via optical connector 316, so that optical fibers 310 and 314 are optically aligned. Insulation

layers 318 and 320 provide electrical insulation between the electrical conductors 306 and 308 and the solder ring 126. The layers may be, for example, spin-on glass, or a thin film passivation layer such as SiNx or SiO2. The layer is preferably thin enough that it does not impede the creation of the solder joint between the solder rings. A polymer layer 322 (such as a polyimide layer) separates the heater 304 from the transparent switch substrate 120.

FIG. 4 is a view of the under side of the transparent channel support plate 102. The upper solder ring 114 is attached to the perimeter of the inner surface of the transparent channel support plate 102. A channel 402 is contained in the polymer layer 104. The adhesive 112 is not shown in this view. Within the channel are heater cavities, 302 and 404, and switching channel 106. Within the switching channel 106 are three contact pads 406, 116 and 408. The surfaces of the contact pads are wettable by liquid metal. The section 1-1 is shown as the upper part in **FIG. 1**. The section 3-3 is shown rotated 90° as the upper part in **FIG. 3**. The section 5-5 is shown rotated 90° as the upper part in **FIG. 5**.

FIG. 5 is a sectional view of an assembled polymeric optical switch through the section 5-5 in **FIG. 4**. The view has been rotated 90°. The figure shows a longitudinal section through the switching channel 106. Within the switching channel 106 are upper contact pads 406, 116 and 408, and lower contact pads 502, 130 and 504. The upper and lower contacts may be coupled to form contact rings. Also contained in the switching channel is a volume of liquid metal, shown as two liquid metal volumes 506 and 508. The liquid metal volumes are held in contact with the contact pads by the surface tension of the liquid metal. The wettable contact pads and

the surface tension of the liquid metal provide a latching mechanism for the switch. With the liquid metal distributed as shown in **FIG. 5**, the optical path between the optical fibers 108 and 122 is blocked by the liquid metal, while the path between optical fibers 310 and 314 is open. When a voltage is applied to the heater (304 in **FIG. 3**), the pressure in the heater cavity (302 in **FIG. 3**) is increased. The heater cavity is coupled to the switching cavity, and the pressure in the right hand end of the switching cavity in **FIG. 5** is also increased. The increased pressure overcomes the surface tension and breaks the liquid metal bond between the contact pads 408 and 504 and the contact pads 116 and 130. Some of the liquid metal is moved along the switching channel and coalesces with the liquid metal volume 508. In this manner, the optical path is opened between the optical fibers 108 and 122, while the liquid metal blocks the path between optical fibers 310 and 314. The resulting switched state is shown in **FIG. 6**. When a voltage is applied to a corresponding heater in heater cavity 404 (shown in **FIG. 4**), the switch-state is reversed.

FIG. 7 is a view of the inner surface of the lower part of the switch, i.e. the upper surface of the transparent switch substrate 120. The lower solder ring 126 covers the perimeter of the transparent switch substrate 120. The solder itself is not shown in this view. Heater 304 is positioned on the substrate so as to align with the heater cavity 302 (shown in **FIG. 3** and **FIG. 4**) when the switch is assembled. Heater 702 is positioned on the substrate so as to align with the heater cavity 404 (shown in **FIG. 4**) when the switch is assembled. Electrical connections 306 and 308 extend from the heater 304 to the edges of the substrate, so that an electrical voltage can be applied to the heater 322. Electrical connections 308 and 306 extend from the

heater 304 to the edges of the substrate, so that an electrical voltage can be applied to the heater 304. Alternatively, the electrical conductors could be passed through vias in the switch substrate. Insulation layers 318 and 320 isolate the electrical connections from the solder ring 126. A polymer layer 322 separates the heater 304 from the transparent switch substrate 120. Corresponding connections and insulation layers are used to connect the second heater 702 to the edge of the substrate. Contact pads 502, 130 and 504 have a surface that is wettable by the liquid metal in the switching chamber. The section 1-1 is shown as the lower part in **FIG. 1**. The section 3-3 (rotated 90°) is shown as the lower part in **FIG. 3**. The section 5-5 is shown (rotated 90°) as the lower part in **FIG. 5**.

FIG. 8 is a view of the outer surface of the transparent channel support plate 102. Attached to the plate are optical connectors 312 and 110, which couple optical fibers 310 and 108 to the plate.

While the invention has been described in conjunction with specific embodiments, it is evident that many alternatives, modifications, permutations and variations will become apparent to those of ordinary skill in the art in light of the foregoing description. Accordingly, it is intended that the present invention embrace all such alternatives, modifications and variations as fall within the scope of the appended claims.

CLAIMS

1. A polymeric optical switch, comprising:

a polymer layer;

a switching channel formed in the polymer layer;

a switch substrate having an inner surface and an outer surface, the inner surface being attached to the polymer layer;

a liquid metal switch formed on the inner surface of the switch substrate and contained within the switching channel; and

a first optical path passing through the switching channel.

2. A polymeric optical switch in accordance with claim 1, further comprising a layer of adhesive between the switch substrate and the polymer layer.

3. A polymeric optical switch in accordance with claim 1 or 2, further comprising a channel support plate having an inner surface and an outer surface, the inner surface of the channel support plate being attached to the polymer layer so that the polymer layer lies between the channel support plate and the switch substrate.

4. A polymeric optical switch in accordance with claim 3, wherein the channel support plate and the switch substrate are transparent.

5. A polymeric optical switch in accordance with claim 3 or 4, wherein at least one of the channel support plate and the switch substrate is glass.

6. A polymeric optical switch in accordance with any of claims 3 to 5, wherein at least one of the channel support plate and the switch substrate is quartz.

7. A polymeric optical switch in accordance with claim 4, further comprising:

a first optical connector coupled to the outer surface of the channel support plate; and

a second optical connector coupled to the outer surface of the switch substrate, the second optical connector being optically aligned with the first optical connector to form a first optical path through the switching channel.

8. A polymeric optical switch in accordance with any of claims 3 to 7, further comprising an hermetic seal between the channel support plate and the switch substrate, the hermetic seal, the channel support plate and the switch substrate enclosing the polymer layer.

9. A polymeric optical switch in accordance with claim 8, wherein the hermetic seal comprises:

a first solder ring attached to the perimeter of the inner surface of the channel support plate and surrounding the polymer layer;

a second solder ring attached to the perimeter of the inner surface of the switch substrate; and

a solder joint connecting the first and second solder rings.

10. A polymeric optical switch in accordance with claim 9, wherein the first and second solder rings are wettable by molten solder.

11. A polymeric optical switch in accordance with any preceding claim, wherein the liquid metal switch comprises:

a first outer contact pad located in the switching channel and having a surface wettable by a liquid metal;

a second outer contact pad located in the switching channel and having a surface wettable by a liquid metal;

a middle contact pad located in the switching channel between the first and second outer contact pads and having a surface wettable by a liquid metal;

a first liquid metal volume contained within the switching cavity and in wetted contact with the first outer contact pad;

a second liquid metal volume contained within the switching cavity and in wetted contact with the second outer contact pad; and

a third liquid metal volume contained within the switching cavity and in wetted contact with the middle contact pad;

wherein the third liquid metal volume is adapted to coalesce with one of the first liquid metal volume and the second liquid metal volume.

12. A polymeric optical switch in accordance with claim 11, wherein the first optical path lies between the first and third liquid metal volumes and is broken when the first and third liquid metal volumes coalesce.

13. A polymeric optical switch in accordance with claim 12, wherein the liquid metal switch further comprises:

a first heater cavity formed in the polymer layer and coupled to the switching channel;

a second heater cavity formed in the polymer layer and coupled to the switching channel;

a first heater positioned in the first heater cavity and adapted to heat a fluid in the first cavity; and

a second heater positioned in the second heater cavity and adapted to heat a fluid in the second cavity;

wherein operation of the first heater causes the third liquid metal volume to coalesce with the first liquid metal volume and operation of the second heater causes third liquid metal volume to coalesce with the second liquid metal volume.

14. A polymeric optical switch in accordance with claim 13, further comprising:

a first electrical connection formed on the inner surface of the switch substrate and electrically connected to the first heater; and

a second electrical connection formed on the inner surface of the switch substrate and electrically connected to the second heater.

15. A polymeric optical switch in accordance with claim 13 or 14, wherein at least one of the first heater and the second heater is separated from the switch substrate by a pad having a low thermal conductivity.

16. A polymeric optical switch in accordance with any of claims 13 to 15, wherein the pad having a low thermal conductivity is made of polymer material.

17. A polymeric optical switch in accordance with any of claims 11 to 16, further comprising a second optical path passing through the switching channel between the second and third liquid metal volumes, the second optical path being broken when the second and third liquid metal volumes coalesce.

18. A polymeric optical switch in accordance with any of claims 11 to 17, wherein the first and second outer contact pads and the middle contact pad are fixed to the inner surface of the switch substrate.

19. A polymeric optical switch in accordance with any of claim 11 to 18, further comprising a channel support plate having an inner surface and an outer surface.

20. A polymeric optical switch in accordance with claim 19, wherein the first and second outer contact pads and the middle contact pad are fixed to the inner surface of the channel support plate.

21. A polymeric optical switch in accordance with claim 19 or 20, wherein at least one of the first outer contact pad, the second outer contact pad and the middle contact pad comprises a pair of contact pads, one of the pair of contact pads being fixed to the inner surface of the channel support plate and the other being fixed to the inner surface of the switch substrate.

22. A polymeric optical switch in accordance with any of claims 19 to 21, wherein at least one of the first outer contact pad, the second outer contact pad and the middle contact pad comprises a contact ring attached to the walls of the switching channel.

23. A polymeric optical switch in accordance with any preceding claim, wherein the polymer layer is composed of polyimide.

24. A polymeric optical switch in accordance with any preceding claim, wherein the polymer layer is composed of Kapton.

25. A polymeric optical switch in accordance with any preceding claim, wherein the switch substrate is composed of a polymer.

26. A polymeric optical switch in accordance with any preceding claim, produced by a method of micro-machining.

27. A method for manufacturing a polymeric optical switch, the method comprising:

forming a plurality of contact pads on a switch substrate;

forming a heater on the switch substrate;

forming a channel structure in a layer of polymer, the channel structure having a switching channel and a heater cavity coupled to the switching channel;

placing a volume of liquid metal on at least one of the plurality of contact pads; and

attaching the switch substrate to the polymer layer, such that the heater is in the heater cavity and the plurality of contact pads are in the switching cavity.

28. A method in accordance with claim 27, wherein the channel structure in the layer of polymer is formed by micro-machining.

29. A method in accordance with claim 27, wherein the channel structure in the layer of polymer is formed by laser ablation of the layer of polymer.

30. A method in accordance with any of claims 27 to 29, wherein the polymer layer is formed on a channel support plate.

31. A method in accordance with claim 30, further comprising:

attaching a first solder ring to the perimeter of the inner surface of the channel support plate, the first solder ring being wettable by molten solder;

attaching a second solder ring to the perimeter of the inner surface of a switch substrate, the second solder ring being wettable by molten solder; and

soldering the first solder ring to the second solder ring to form a seal around the polymer layer.

32. A method in accordance with claim 30 or 31, wherein forming the channel structure in the layer of polymer comprises:

coating the channel support plate with a liquid polymer;

curing the liquid polymer; and

ablating the polymer using a laser to form the channel structure.

33. A method in accordance with claim 30 or 31, wherein forming the channel structure in the layer of polymer comprises:

covering a surface of the channel support plate with a polymer; and

forming the channel structure by photo-imaging.

34. A method in accordance with any of claims 27 to 33, wherein the attaching the switch substrate to the polymer layer comprises:

applying a layer a adhesive to at least one of the polymer layer and the switch substrate; and

bringing the polymer layer and the switch substrate into contact.

35. A polymeric optical switch substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

36. A method for manufacturing a polymeric optical switch substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

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Application No: GB0407168.4 24 **Examiner:** Mr Chris Ross

Claims searched: 1-26,35 **Date of search:** 5 August 2004

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular reference
A	-	GB2381595 A (AGILENT) whole document

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
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Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^{W} :

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G02B

The following online and other databases have been used in the preparation of this search report

Online: WPI, EPODOC, JAPIO, TXTE