[0051] **FIG. 12B** shows a top view of a display component that has an active matrix display backplane attached thereto.

[0052] **FIG. 13** shows a top view of flexible substrate attached to a display backplane.

[0053] **FIG. 14A** shows a planar side view of a backplane interconnect layer coupled to a flexible substrate.

[0054] **FIG. 14B** shows a planar side view of a backplane interconnect layer coupled to a flexible substrate wherein blocks are coupled to the backplane interconnect layer and to the flexible substrate.

[0055] **FIG. 14C** shows a planar side view of a flexible reflective display coupled to a flexible substrate that has holes or recesses to accept blocks.

[0056] **FIG. 15A** shows a flow chart of a method of fabricating a display device wherein a flexible substrate and a display tape undergo processing and are subsequently coupled.

[0057] **FIG. 15B** shows schematically a method of fabricating a display device wherein a flexible substrate and a display tape undergo processing and are subsequently coupled.

[0058] **FIG. 16** shows a flow chart of a method of the picking and placing objects onto a flexible substrate after the FSA process has been applied to the substrate.

[0059] **FIG. 17** shows a flow chart that relates to the FSA process and the coupling of the display material to the substrate.

[0060] **FIG. 18** shows a top view of a flexible continuous substrate wherein displays of different sizes are created.

[0061] **FIG. 19** shows a top view of a flexible continuous substrate wherein displays of similar size are created.

[0062] **FIG. 20** shows a planar side view of the recessed regions in the substrate.

[0063] **FIG. 21** shows an embodiment of the overall in-line process of the invention.

[0064] **FIG. 22** shows a top view of display material being placed through a screen onto display tape

[0065] **FIG. 23** shows a top view of display material being laser etched onto display tape.

[0066] **FIG. 24** shows a top view of display material wherein lithography is used to pattern the display material.

[0067] **FIG. 25** shows a top view of display material that is deposited in a pattern onto display tape.

[0068] **FIG. 26A** shows a planar side view of a substrate.

[0069] **FIG. 26B** shows openings or receptor regions created and blocks deposited into the substrate.

[0070] **FIG. 26C** shows deposition of planarization material and openings being created into the substrate.

[0071] **FIG. 26D** shows deposition of interconnect and pattern interconnect.

DETAILED DESCRIPTION

[0072] The present invention relates to apparatuses and methods for forming displays. The following description and drawings are illustrative of the invention and are not to be construed as limiting the invention.

[0073] One embodiment in accordance with the invention includes a flexible active matrix display panel coupled to a substrate. By fabricating an active matrix display device that is flexible, the active matrix display panel can be fitted to an object that is either rigid or flexible and that has a non-planar surface. Other embodiments of the invention include a method of making a flexible continuous substrate upon which multiple flexible displays are fabricated. The multiple flexible displays may be of similar or different sizes. These displays are separated from one another as the substrate is advanced through the web processing apparatus. The backplane of the display may be comprised of a plurality of blocks wherein each block has a circuit element thereon. The blocks are contained in a slurry that is deposited onto the flexible substrate. Although blocks may be comprised of single crystal silicon or other like material which makes the block rigid, the substrate may still be flexible because the size of these blocks (50×100 microns or 100×100 microns) is small in comparison to the flexible substrate. These blocks may also have recessed regions wherein another micro-electro-mechanical structural element may be deposited thereon. The flexible substrate forms part of a display backplane. The flexible displays may be either an active matrix or a passive matrix displays.

[0074] Another embodiment of the invention relates to a flexible substrate with a reflective display backplane.

[0075] Another embodiment of the invention involves using FSA generally with a flexible web processed material. Incorporated by reference is U.S. Pat. No. 5,545,291 explaining how to assemble microstructures onto a substrate. With embodiments of the invention, a flexible substrate is advanced through a web process apparatus. The FSA with a plurality of blocks (or other functional elements) is deposited onto the flexible substrate wherein the blocks fall into recessed regions found in the flexible substrate. The substrate is then advanced to a further point in the process wherein an interconnect layer is deposited onto the substrate. While the substrate is advanced, a display tape is advanced to a point wherein the flexible substrate becomes coupled to the display tape.

[0076] Before the coupling takes place, a metal interconnect is placed onto the backplane. A display material is then deposited onto the display tape. The display material may be cholesteric liquid crystal, polymer-dispersed liquid crystal or other type of material. The display material is layered or patterned on the display tape. The display tape is then advanced to a point wherein the metal interconnect is deposited or etched on the display material. This is done by using laser etch, ink jet, screen print, deposit, or lithography and etch. After this point, the display tape may be laser cut, punched, sealed, or trimmed. Coupling takes place at a point further along in the process.

[0077] Another embodiment of the invention relates to the FSA process wherein, after the blocks are deposited on the substrate, they fall into recessed regions found in the substrate. After a certain time period, the substrate is checked for any existing empty recessed regions. Finding empty recessed regions is accomplished by using an electronic eye attached to a machine that is able to view the surface of the substrate. A robot or a person is used to place an object on an empty recessed region.