

CLAIMS

1. An apparatus comprising:
 - a first frame to hold a wafer tape having a first side and a second side, a plurality of semiconductor device dies being disposed on the first side of the wafer tape;
 - a second frame including a first clamping member and a second clamping member to clamp therebetween a product substrate having a circuit trace thereon, the second frame configured to hold the product substrate such that the circuit trace is disposed facing the plurality of semiconductor device dies on the wafer tape;
 - a needle disposed adjacent the second side of the wafer tape, a length of the needle extending in a direction toward the wafer tape;
 - a needle actuator connected to the needle to move the needle to a die transfer position at which the needle presses on the second side of the wafer tape to press a semiconductor device die of the plurality of semiconductor device dies into contact with the circuit trace on the product substrate; and
 - a laser pointing toward a portion of the product substrate corresponding to the transfer position at which the semiconductor device die contacts the circuit trace to apply energy to the circuit trace to affix the semiconductor device die to the circuit trace,
 - wherein the laser is positioned within the apparatus such that the energy from the laser is applied directly on the product substrate during a transfer operation.
2. The apparatus according to claim 1, further comprising a controller communicatively coupled to the first frame and the second frame, the controller including memory having instructions, which when executed, cause:
 - the first frame to be oriented such that the semiconductor device die on the wafer tape is aligned with the transfer position; and
 - the second frame to be oriented such that the portion of the product substrate is aligned with the transfer position.
3. The apparatus according to claim 1, further comprising:
 - a first optical sensor positioned above the first frame to sense a position of a particular die with respect to the transfer position; and

a second optical sensor positioned above the second frame to sense a position of the circuit trace with respect to the transfer position.

4. The apparatus according to claim 1, wherein the laser emits energy as light having a preselected wavelength, and wherein the wavelength of the light is preselected based, at least in part, on a level of absorption of the preselected wavelength by a conductive ink of the circuit trace, and a level of absorption of the preselected wavelength by the product substrate.
5. The apparatus according to claim 1, further comprising a wafer tape support structure including a perforated base portion disposed adjacent to a surface of the second side of the wafer tape, the wafer tape support structure being arranged and aligned with respect to the needle and the needle actuator such that the needle reciprocates freely through a perforation in the base portion to reach the wafer tape.
6. The apparatus according to claim 1, wherein a width of an end of the needle that contacts a device die during a transfer operation is sized based, at least in part, on a width of the plurality of semiconductor device dies to be transferred, respectively, the device dies including unpackaged LEDs.
7. The apparatus according to claim 1, wherein the laser is positioned beneath the second frame.
8. The apparatus according to claim 1, wherein the laser is positioned above the second frame.
9. An apparatus comprising:
 - a first frame to hold a wafer tape having a first side and a second side, a plurality of semiconductor device dies being disposed on the first side of the wafer tape;
 - a second frame including a first clamping member and a second clamping member to clamp therebetween a product substrate having a circuit trace thereon, the second frame configured to hold the product substrate such that the circuit trace is disposed facing the plurality of semiconductor device dies on the wafer tape;

a needle disposed adjacent the second side of the wafer tape, a length of the needle extending in a direction toward the wafer tape;

a needle actuator connected to the needle to move the needle to a die transfer position at which the needle presses on the second side of the wafer tape to press a semiconductor device die of the plurality of semiconductor device dies into contact with the circuit trace on the product substrate;

a laser pointing toward a portion of the product substrate corresponding to the transfer position at which the semiconductor device die contacts the circuit trace to apply energy to the circuit trace to affix the semiconductor device die to the circuit trace; and

a wafer tape support structure including a perforated base portion disposed adjacent to a surface of the second side of the wafer tape, the wafer tape support structure being arranged and aligned with respect to the needle and the needle actuator such that the needle reciprocates freely through a perforation in the base portion to reach the wafer tape.