

## METHODS AND SYSTEMS FOR PROCESSING SEMICONDUCTOR WORKPIECES

### TECHNICAL FIELD

[0001] The present disclosure is related to methods and systems for processing semiconductor workpieces; several examples of such methods and systems are directed to at least partially detaching a microelectronic die from a releasable film.

### BACKGROUND

[0002] Processors, memory devices, imagers, and other types of microelectronic devices are often manufactured on semiconductor workpieces or other types of workpieces. In a typical application, several individual dies (e.g., devices) are fabricated on a single workpiece using sophisticated and expensive equipment and processes. Individual dies generally include an integrated circuit and a plurality of bond-pads coupled to the integrated circuit. The bond-pads provide external electrical contacts on the die through which supply voltage, signals, etc., are transmitted to and from the integrated circuit. The bond-pads are usually very small, and they are arranged in an array having a fine pitch between bond-pads. The dies can also be quite delicate. As a result, after fabrication, the dies are packaged to protect the dies and to connect the bond-pads to another array of larger terminals that is easier to connect to a printed circuit board. The package can then be electrically connected to other microelectronic devices or circuits in many types of consumer or industrial electronic products.

[0003] Electronic product manufacturers are under continuous pressure to reduce the size of their products. Accordingly, microelectronic die manufacturers seek to reduce the size of the packaged dies incorporated into the electronic products. One approach to reducing the size of the packaged dies is to reduce the thickness of the dies. For example, the backside of a wafer is often ground to reduce the thickness of the dies formed on the wafer. After backgrinding, the wafer is

attached to a wafer mounting tape and then cut to singulate the dies. A drawback with this approach is that the thin dies are extremely fragile and difficult to handle.

[0004] One conventional device for detaching dies from the wafer mounting tape includes an array of pins that are aligned with a particular die and press against the backside of the tape to detach the die from the tape. One problem with this device is that the pins can crack the thin die because the individual pins exert a force over a relatively small area. Another conventional device for detaching dies from the wafer mounting tape includes a ramp that moves vertically to press against the backside of the tape while the tape and dies move horizontally across the ramp. One problem with this device is the ramp may bend the thin dies, which can also crack the dies. Accordingly, there is a need to improve the handling of semiconductor workpieces during processing.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0005] Figure 1 is a schematic side cross-sectional view of a system for processing a semiconductor workpiece having a plurality of microelectronic dies in accordance with one embodiment of the disclosure.

[0006] Figure 2 is a schematic isometric view of the contact assembly of Figure 1.

[0007] Figures 3-5 illustrate stages in a method for detaching a die from the support structure in accordance with one embodiment of the disclosure.

[0008] Figure 3 is a schematic side cross-sectional view of the system after rotating the contact assembly from a first position to a second position.

[0009] Figure 4 is a schematic side cross-sectional view of the system after rotating the contact assembly from the second position to a detach position.

[0010] Figure 5 is a schematic side cross-sectional view of the system after rotating the contact assembly from the detach position to a third position.

[0011] Figure 6 is a schematic isometric view of a contact assembly in accordance with another embodiment of the disclosure.

[0012] Figure 7 is a schematic side view of a contact member in accordance with another embodiment of the disclosure.

[0013] Figure 8 is a schematic side view of a contact member in accordance with another embodiment of the disclosure.

[0014] Figure 9 is a schematic side view of a contact member in accordance with another embodiment of the disclosure.

#### DETAILED DESCRIPTION

[0015] Specific details of several embodiments of the disclosure are described below with reference to microelectronic dies and systems for processing the dies. The microelectronic dies can include micromechanical components, data storage elements, optics, read/write components, or other features. For example, the microelectronic dies can be SRAM, DRAM (e.g., DDR-SDRAM), flash-memory (e.g., NAND flash-memory), processors, imagers, and other types of devices. Moreover, several other embodiments of the invention can have different configurations, components, or procedures than those described in this section. A person of ordinary skill in the art, therefore, will accordingly understand that the invention may have other embodiments with additional elements, or the invention may have other embodiments without several of the elements shown and described below with reference to Figures 1-9.

[0016] Figure 1 is a schematic side cross-sectional view of a system 100 for processing a semiconductor workpiece 108 having a plurality of microelectronic dies 110 in accordance with one embodiment of the disclosure. The illustrated workpiece 108 is a wafer that has been cut to singulate the dies 110. The individual dies 110 include an active side 112, a backside 114 opposite the active side 112, a plurality of terminals 116 (e.g., bond-pads) arranged in an array on the active side 112, and an integrated circuit 118 (shown schematically) operably coupled to the terminals 116. Although the illustrated dies 110 have the same structure, in other embodiments the dies can have different features to perform different functions.

[0017] The illustrated system 100 includes a support structure 130 for carrying the dies 110, a detachment apparatus 140 for at least partially detaching the dies 110 from the support structure

130, and a pick-and-place apparatus 190 for removing the dies 110 from the support structure 130. The support structure 130 is configured to releasably support the workpiece 108 during one or more processing procedures. For example, the illustrated support structure 130 includes a dicing support having an annular frame 132 carrying a releasable attachment member or film 134. The releasable film 134 has a first surface 135a and a second surface 135b opposite the first surface 135a. The illustrated support structure 130 also includes an adhesive 136 (e.g., UV tape) on the first surface 135a of the film 134 for releasably adhering the backsides 114 of the dies 110 to the film 134.

[0018] The detachment apparatus 140 can be positioned at the support structure 130 and aligned with a selected die 110 for at least partially detaching the die 110 from the support structure 130. The illustrated detachment apparatus 140 includes a support member 142 and a contact assembly 146 within the support member 142. The support member 142 has an opening 143 exposing the contact assembly 146 and a support surface 144 positioned to contact and support the second surface 135b of the releasable film 134. In other embodiments, the detachment apparatus 140 may not include the support member 142.

[0019] Figure 2 is a schematic isometric view of the contact assembly 146. Referring to both Figures 1 and 2, the embodiment of the illustrated contact assembly 146 includes a first shaft 148a, a first contact member 150a attached to the first shaft 148a, a second shaft 148b (Figure 2), and a second contact member 150b attached to the second shaft 148b. The first and second shafts 148a-b can be positioned in a co-axial arrangement and aligned with an axis A-A, but are spaced apart from each other such that the shafts 148 can rotate in opposite directions about the axis A-A. The first and second contact members 150a-b include outer surfaces 152 (identified individually as 152a-b), inner surfaces 154 (identified individually as 154a-b), an aperture 156 sized to receive the corresponding shaft 148, and a thickness T between the outer and inner surfaces 152 and 154. The outer surfaces 152 and the inner surfaces 154 can be generally planar. The inner surfaces 154a-b of the first and second contact members 150a-b are spaced apart by a first distance  $D_1$ , and the outer surfaces 152a-b of the first and second contact members 150a-b are spaced apart by a second distance  $D_2$ . The second distance  $D_2$  may be approximately equal to or less than a transverse dimension of the individual dies 110, and the individual contact members 150 have a length  $L_1$  that

is approximately equal to 75% of a length  $L_2$  of the individual dies 110. In other embodiments, the contact members 150 may have a different size and/or configuration.

[0020] The embodiment of the illustrated first and second contact members 150a-b are cams with an arcuate surface 158 positioned to contact the second surface 135b of the releasable film 134. The arcuate surface 158 can extend between the outer and inner surfaces 152 and 154 and include a first section 160 with a generally uniform first radius of curvature and a second section 162 with a variable radius of curvature. In one specific embodiment, the second section 162 of the arcuate surface 158 includes a first portion 164a with a second radius of curvature greater than the first radius of curvature and a second portion 164b with a third radius of curvature less than the first radius of curvature. As such, such examples of the contact members 150a-b have a first dimension  $R_1$  between the aperture 156 and the first section 160, and a second dimension  $R_2$  between the aperture 156 and the second portion 164b. In other embodiments, the contact members 150 can have a different configuration. In either case, the first and second contact members 150a-b are attached to the first and second shafts 148a-b, respectively, in an eccentric arrangement.

[0021] In the illustrated embodiment, the detachment apparatus 140 further includes a first motor 170a operably coupled to the first shaft 148a and a second motor 170b (Figure 2) operably coupled to the second shaft 148b. The first motor 170a is configured to rotate the first shaft 148a and the first contact member 150a in a first direction  $S_1$  about the axis A-A, and the second motor 170b is configured to rotate the second shaft 148b and the second contact member 150b in a second direction  $S_2$  about the axis A-A. The first and second motors 170a-b can rotate the first and second contact members 150a-b, respectively, at a generally constant angular velocity or at a variable angular velocity. In other embodiments, the motors 170 can rotate the contact members 150 in the same direction, or the detachment apparatus 140 may include only a single contact member 150 for detaching each die 110. In still other embodiments, the detachment apparatus 140 may have a single motor, first and second contact member 150a and 150b, and gearing, linkage or another transfer system that couples the output of the motor to the contact members 150a-b either independently or together.

[0022] Figures 3-5 illustrate stages in a method for detaching a first die 110a from the support structure 130 in accordance with one embodiment of the disclosure. For example, Figure 3 is a

schematic side cross-sectional view of the system 100 after pivoting the contact assembly 146 from (a) a first position (shown in Figure 1) in which the releasable film 134 and the first die 110a are not displaced to (b) a second position in which the releasable film 134 and the first die 110a are displaced. Specifically, as the first and second contact members 150a-b pivot about the axis A-A in the first and second directions  $S_1$  and  $S_2$ , respectively, the first portions 164a of the arcuate surfaces 158 slide across the second surface 135b of the releasable film 134. Because the arcuate surfaces 158 of the contact members 150 are arranged eccentrically relative to the shafts 148, the arcuate surfaces 158 drive the portion of the film 134 at the points of contact and the first die 110a in a direction X generally normal to a plane defined by the unflexed releasable film 134. As the releasable film 134 flexes, portions of the film 134 adjacent to the points of contact detach from the first die 110a.

[0023] Figure 4 is a schematic side cross-sectional view of the system 100 after rotating the contact assembly 146 from the second position (shown in Figure 3) to a detach position. In the detach position, the distal ends 163 of the contact members 150 are positioned against the releasable film 134 and much of the film 134 adjacent to the first die 110a has detached from the first die 110a. After the detachment apparatus 140 has at least partially decoupled the first die 110a from the releasable film 134, the pick-and-place apparatus 190 grasps the active side 112 of the die 110a and removes the die 110a from the support structure 130.

[0024] Figure 5 is a schematic side cross-sectional view of the system 100 after rotating the contact assembly 146 from the detach position (shown in Figure 4) to a third position. As the first and second contact members 150a-b pivot from the detach position to the third position, the releasable film 134 returns to a generally unflexed position. In several embodiments, the contact members 150 may not contact the releasable film 134 when the members 150 pivot from the third position back to the first position. In other embodiments, the contact members 150 may contact but not significantly displace the releasable film 134 as the members 150 rotate from the third position to the first position. In either case, the detachment apparatus 140 can move relative to the support structure 130 to align the contact assembly 146 with another die 110 after the pick-and-place apparatus 190 has secured the first die 110a.

[0025] Several embodiments of the system 100 illustrated in Figures 1-5 are expected to at least partially detach one or more dies 110 from the releasable film 134 without cracking or otherwise damaging the dies 110. Because the contact members 150 have a thickness T, the forces exerted on the dies 110 by the contact members 150 are distributed over a surface area sufficiently large to reduce or avoid cracking of the dies 100. The surface area, however, is still small enough to detach the dies 110 from the film 134. As such, the system 100 is expected to increase the yield of the dies 110.

[0026] Several embodiments of the system 100 illustrated in Figures 1-5 are expected to increase the throughput of the production process. Specifically, the contact members 150 include an arcuate surface 158 with a first portion 164a and a second portion 164b. The first portion 164a is positioned to exert a force on the releasable film 134 and the die 110 when the backside 114 of the die 110 is completely attached to the film 134. The curvature of the first portion 164a is shaped to move the die 110 in the direction X at a first speed. The second portion 164b is positioned to exert a force on the releasable film 134 and the die 110 when the backside 114 of the die 110 is partially detached from film 134. The curvature of the second portion 164b is shaped to move the die 110 in the direction X at a second speed greater than the first speed. The contact members 150 accordingly move the die 110 at an initial speed when the die 110 is completely attached to the releasable film 134 and more susceptible to cracking, and a faster speed when the die 110 is partially detached from the film 134 and less likely to crack. As a result, the system 100 can detach dies 110 at a faster rate to increase throughput.

[0027] In one embodiment, a method for decoupling a microelectronic die from a first side of a releasable film includes applying a first force against a second side of the releasable film to move the microelectronic die in a first direction at a first speed. After applying the first force, the method includes applying a second force against the second side of the releasable film to move the microelectronic die in the first direction at a second speed different than the first speed.

[0028] In another embodiment, a method for processing a semiconductor workpiece includes releasably attaching a plurality of microelectronic dies to a first side of a releasable film, and at least partially detaching one of the microelectronic dies from the releasable film by pivoting a contact member with a surface of the contact member pressing against a second side of the releasable film.

[0029] In another embodiment, a method for processing a microelectronic die includes providing the die on a first side of a releasable attachment member, contacting a second side of the releasable attachment member with an arcuate surface, and moving the arcuate surface relative to the attachment member to at least partially decouple the die from the attachment member.

[0030] In another embodiment, a system for at least partially decoupling a microelectronic die from a releasable film includes a support member configured to carry the releasable film, and a contact assembly including a cam positioned to contact the releasable film.

[0031] In another embodiment, a system for at least partially detaching a microelectronic die from a releasable film includes a support member for carrying the releasable film, and a contact assembly having a shaft and a contact member coupled to the shaft. The contact member has a surface positioned to contact the releasable film. The system further includes a motor operably coupled to the shaft to pivot the shaft and move the surface of the contact member relative to the releasable film.

[0032] In another embodiment, a system for at least partially decoupling a microelectronic die from a releasable film includes a support member configured to carry the releasable film, and means for applying a first force against the releasable film to urge the die in a first direction at a first speed and subsequently applying a second force against the releasable film to urge the die in the first direction at a second speed different than the first speed.

[0033] Figure 6 is a schematic isometric view of a contact assembly 246 in accordance with another embodiment of the disclosure. The illustrated contact assembly 246 is generally similar to the contact assembly 146 described above with reference to Figures 1 and 2. For example, the illustrated contact assembly 246 includes first and second contact members 250a-b having an arcuate surface 258 with a first section 260 and a second section 262. The second section 262 in the illustrated embodiment, however, includes a groove 266 and a plurality of ball bearings 268 received in the groove 266. The groove 266 is configured to retain the bearings 268 within the groove 266 while allowing the bearings 268 to spin. The ball bearings 268 are positioned to project a short distance from the groove 266 and contact the second surface 135b (Figure 1) of the releasable film 134 (Figure 1). The ball bearings 268 are expected to reduce friction between the

arcuate surface 258 and the second surface 135b of the releasable film 134 and thereby reduce or eliminate the concomitant distortion or damage of the film 134. In other embodiments, the first section 260 of the arcuate surface 258 may also include the groove 266 and the ball bearings 268. In additional embodiments, the contact assembly 246 can include a lubricant and/or a different device (e.g., cylindrical rollers instead of ball bearings) for reducing friction between the contact members 250 and the releasable film 134.

[0034] Figures 7-9 are schematic side views of different profiles of contact members in accordance with several embodiments of the disclosure. For example, Figure 7 is a schematic side view of a contact member 350 having an arcuate surface 358 with a first section 160 and a second section 362. The illustrated contact member 350 is generally similar to the contact members 150 described above with reference to Figures 1 and 2. The illustrated contact member 350, however, has a greater radius of curvature at a distal end 363. As such, the illustrated contact member 350 is expected to displace the releasable film 134 and the die 110 at a slower rate when the contact member 350 approaches the detach position.

[0035] Figure 8 is a schematic side view of a contact member 450 in accordance with another embodiment of the disclosure. The contact member 450 is generally similar to the contact member 150 described above with reference to Figures 1 and 2. For example, the contact member 450 includes an arcuate surface 458 having a first section 160 and a second section 462. The illustrated second section 462, however, includes a generally flat surface 464 at a distal end 463. The flat surface 464 is expected to provide a surface on which the die 110 can rest while the pick-and-place apparatus 190 grasps the die 110.

[0036] Figure 9 is a schematic side view of a contact member 550 in accordance with another embodiment of the disclosure. The illustrated contact member 550 is generally similar to the contact member 450 described above with reference to Figure 8. The illustrated contact member 550, however, includes a cutout portion 566 in the second section 462 of the arcuate surface 558. The cutout section 566 enables the releasable film 134 to abruptly drop when the contact member 550 rotates from the detach position to the third position. This is expected to facilitate the detachment of the releasable film 134 from the die 110. In other embodiments, the contact member can have a different profile shaped to meet certain process requirements.

[0037] From the foregoing, it will be appreciated that specific embodiments of the invention have been described herein for purposes of illustration, but that various modifications may be made without deviating from the invention. For example, many of the elements of one embodiment can be combined with other embodiments in addition to or in lieu of the elements of the other embodiments. Accordingly, the invention is not limited except as by the appended claims.

## CLAIMS

I/We claim:

- [c1] 1. A method for processing a semiconductor workpiece, the method comprising:  
releasably attaching a plurality of microelectronic dies to a first side of a releasable film; and  
at least partially detaching one of the microelectronic dies from the releasable film by pivoting a contact member with a surface of the contact member pressing against a second side of the releasable film.
- [c2] 2. The method of claim 1 wherein:  
the contact member comprises a cam; and  
pivoting the contact member comprises pivoting the cam and pressing the cam against the second side of the releasable film.
- [c3] 3. The method of claim 1 wherein:  
the contact member comprises a first contact member; and  
at least partially detaching one of the dies further comprises pivoting a second contact member with a surface of the second contact member pressing against the second side of the releasable film adjacent to the one of the dies.
- [c4] 4. The method of claim 1 wherein:  
the contact member comprises a first contact member;  
pivoting the first contact member comprises pivoting the first contact member about an axis in a first direction; and  
at least partially detaching one of the dies further comprises pivoting a second contact member about the axis in a second direction with a surface of the second contact member pressing against the second side of the releasable film adjacent to the one of the dies, the second direction being opposite the first direction.

- [c5] 5. The method of claim 1 wherein:  
the surface of the contact member comprises a generally flat section; and  
pivoting the contact member comprises pressing the generally flat section against the  
second side of the releasable film.
- [c6] 6. The method of claim 1 wherein:  
the surface of the contact member comprises an arcuate section arranged eccentrically  
about an axis of rotation; and  
pivoting the contact member comprises pressing the arcuate section against the second  
side of the releasable film.
- [c7] 7. The method of claim 1 wherein:  
the surface of the contact member comprises a generally flat section and an arcuate  
section; and  
pivoting the contact member comprises pressing the generally flat section against the  
second side of the releasable film and pressing the arcuate section against the  
second side of the releasable film.
- [c8] 8. The method of claim 1 wherein:  
the surface of the contact member comprises a first arcuate section with a first radius of  
curvature and a second arcuate section with a second radius of curvature  
different than the first radius of curvature; and  
pivoting the contact member comprises pressing the first arcuate section against the  
second side of the releasable film and pressing the second arcuate section  
against the second side of the releasable film.
- [c9] 9. The method of claim 1 wherein:  
the contact member comprises a plurality of ball bearings; and  
pivoting the contact member comprises contacting the second side of the releasable  
film with the ball bearings.

- [c10] 10. A method for decoupling a microelectronic die from a first side of a releasable film, the method comprising:
- applying a first force against a second side of the releasable film to move the microelectronic die in a first direction at a first speed; and
  - after applying the first force, applying a second force against the second side of the releasable film to move the microelectronic die in the first direction at a second speed different than the first speed.
- [c11] 11. The method of claim 10 wherein:
- applying the first force against the releasable film comprises pivoting a contact member about an axis in a first direction over a first angle; and
  - applying the second force against the releasable film comprises pivoting the contact member about the axis in the first direction over a second angle.
- [c12] 12. The method of claim 10 wherein:
- applying the first force against the releasable film comprises pressing a cam against the releasable film; and
  - applying the second force against the releasable film comprises pressing the cam against the releasable film.
- [c13] 13. The method of claim 10 wherein:
- applying the first force against the releasable film comprises pivoting a contact member about an axis at a first angular velocity; and
  - applying the second force against the releasable film comprises pivoting the contact member about the axis at the first angular velocity.
- [c14] 14. The method of claim 10 wherein:
- applying the first force against the releasable film comprises pressing a first cam against the releasable film;

applying the second force against the releasable film comprises pressing the first cam against the releasable film; and

the method further comprises pressing a second cam against the releasable film at the die while pressing the first cam against the releasable film.

[c15] 15. The method of claim 10 wherein:  
the releasable film defines a plane;  
applying the first force against the releasable film comprises moving the die in a direction generally normal to the plane; and  
applying the second force against the releasable film comprises moving the die in the direction generally normal to the plane.

[c16] 16. A method for processing a microelectronic die, the method comprising:  
providing a microelectronic die on a first side of a releasable attachment member;  
contacting a second side of the releasable attachment member with an arcuate surface;  
and  
moving the arcuate surface relative to the releasable attachment member to at least partially decouple the microelectronic die from the releasable attachment member, the second side being opposite the first side.

[c17] 17. The method of claim 16 wherein contacting the second side of the releasable attachment member comprises pressing a cam having the arcuate surface against the second side of the releasable attachment member.

[c18] 18. The method of claim 16 wherein contacting the second side of the releasable attachment member comprises pivoting a contact member having the arcuate surface.

- [c19] 19. The method of claim 16 wherein contacting the second side of the releasable attachment member with the arcuate surface comprises:
- applying a first force against the second side of the releasable attachment member to move the microelectronic die in a first direction at a first speed; and
  - after applying the first force, applying a second force against the second side of the releasable attachment member to move the microelectronic die in the first direction at a second speed different than the first speed.
- [c20] 20. The method of claim 16 wherein:
- the releasable attachment member defines a plane; and
  - moving the arcuate surface comprises moving the die in a direction generally normal to the plane.
- [c21] 21. A method for processing a semiconductor workpiece, the method comprising:
- thinning a semiconductor workpiece;
  - cutting the semiconductor workpiece to singulate a plurality of dies with the workpiece attached to a first side of a releasable attachment member;
  - contacting a second side of the releasable attachment member with an arcuate surface; and
  - moving the arcuate surface relative to the releasable attachment member to at least partially decouple one of the dies from the releasable attachment member, the second side being opposite the first side.
- [c22] 22. The method of claim 21 wherein contacting the second side of the releasable attachment member comprises pressing a cam having the arcuate surface against the second side of the releasable attachment member.
- [c23] 23. A system for at least partially decoupling a microelectronic die from a releasable film, the system comprising:
- a support member configured to carry the releasable film; and

a contact assembly including a cam positioned to contact the releasable film.

[c24] 24. The system of claim 23 wherein:  
the cam includes an aperture and an arcuate surface positioned to contact the releasable film;  
the contact assembly further comprises a shaft attached to the cam and partially received in the aperture; and  
the cam has a first dimension between the aperture and a first section of the arcuate surface and a second dimension between the aperture and a second section of the arcuate surface, the second dimension being different than the first dimension.

[c25] 25. The system of claim 23 wherein the cam comprises an arcuate surface positioned to contact the releasable film, the arcuate surface having a first section with a first radius of curvature and a second section with a second radius of curvature different than the first radius of curvature.

[c26] 26. The system of claim 23 wherein the cam comprises a surface positioned to contact the releasable film, and wherein the surface includes a generally flat section.

[c27] 27. The system of claim 23 wherein the cam comprises a slot and a plurality of ball bearings in the slot, and wherein the ball bearings are positioned to contact the releasable film.

[c28] 28. The system of claim 23 wherein:  
the contact assembly further comprises a shaft; and  
the system further comprises a motor operably coupled to the shaft to rotate the shaft and the cam about an axis.

[c29] 29. The system of claim 23 wherein:  
the cam comprises a first cam positioned to contact the releasable film at the die; and

the contact assembly further includes a second cam positioned to contact the releasable film at the die.

[c30] 30. The system of claim 23, further comprising a pick-and-place apparatus configured to grasp the microelectronic die.

[c31] 31. The system of claim 23 wherein the cam is configured to rotate about an axis, and wherein the cam is positioned and configured to remain in contact with the releasable film as the cam rotates about the axis.

[c32] 32. The system of claim 23 wherein the cam is configured to rotate about an axis, and wherein the cam is configured to contact the releasable film for only part of the rotation about the axis.

[c33] 33. A system for at least partially detaching a microelectronic die from a releasable film, the system comprising:

- a support member for carrying the releasable film;
- a contact assembly including a shaft and a contact member coupled to the shaft, the contact member having a surface positioned to contact the releasable film; and
- a motor operably coupled to the shaft to pivot the shaft and the contact member and move the surface relative to the releasable film.

[c34] 34. The system of claim 33 wherein the surface of the contact member comprises an arcuate section and a generally flat section.

[c35] 35. The system of claim 33 wherein:  
the contact member further includes an aperture sized to receive a portion of the shaft;  
and

the contact member has a first dimension between the aperture and a first section of the surface and a second dimension between the aperture and a second section of the surface, the second dimension being different than the first dimension.

[c36] 36. The system of claim 33 wherein the surface has a first section with a first radius of curvature and a second section with a second radius of curvature different than the first radius of curvature.

[c37] 37. A system for at least partially decoupling a microelectronic die from a releasable film, the system comprising:

a support member configured to carry the releasable film; and

means for applying a first force against the releasable film to urge the microelectronic die in a first direction at a first speed and subsequently applying a second force against the releasable film to urge the die in the first direction at a second speed different than the first speed.

[c38] 38. The system of claim 37 wherein the means for applying the first and second forces comprise a cam positioned to contact the releasable film.

[c39] 39. The system of claim 37 wherein the releasable film defines a plane, and wherein the first direction is generally normal to the plane.

[c40] 40. The system of claim 37 wherein the means for applying the first and second forces comprise a contact member configured to pivot about an axis and positioned to contact the releasable film.

[c41] 41. The system of claim 37 wherein the means for applying the first and second forces comprise a contact member including a surface positioned to contact the releasable film at the die, the surface having a first section with a first radius of curvature and a second section with a second radius of curvature different than the first radius of curvature.

[c42] 42. The system of claim 37 wherein the means for applying the first and second forces comprise a first contact member positioned to contact the releasable film and a second contact member positioned to contact the releasable film, the second contact member being spaced apart from the first contact member.