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(71) Applicant: **ILLINOIS TOOL WORKS INC.** [US/US];
3600 West Lake Avenue, Glenview, IL 60025 (US).

(72) Inventor: **FORSYTH, Valoris, L.**; 1331 Brazos Blvd.,
Lewisville, TX 75067 (US).

(74) Agents: **LEVY, Gerald** et al.; Pitney Hardin LLP, 7 Times
Square, New York, NY 10036-7311 (US).

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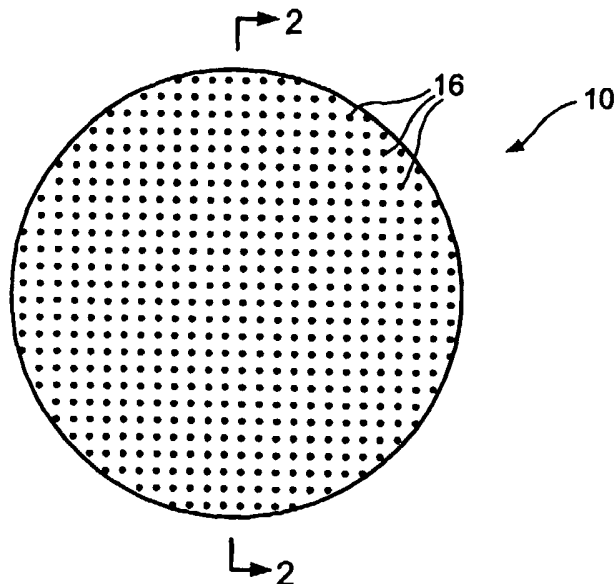
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ning of each regular issue of the PCT Gazette.

(54) Title: **FOAM LAMINATES SYSTEM FOR SEMICONDUCTOR WAFERS**



(57) Abstract: A cushion-like device (10) is provided for the transportation of semiconductor wafers. The device includes an interior formed from polyethylene closed cell foam that utilizes a foaming agent that imparts minimal alkanes and cations into the polyethylene foam material. An electrostatic discharge dissipative polyethylene film surrounds the foam interior and is joined thereto by hot melt EVA material. An array of apertures (16) of approximately 0.010 inch diameter and less than 0.25 inch spacing is formed in the film to allow the foam to compress upon impact.

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FOAM LAMINATE SYSTEM FOR SEMICONDUCTOR WAFERS

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a foam laminate system for use in semiconductor wafer transportation, particularly from the front-end to an assembly location.

Description of the Prior Art

The transportation of semiconductor wafers, particularly transportation from the front-end to an assembly location, which typically may involve a trans-oceanic voyage, presents a set of challenges. Mechanical and electrostatic protection must be provided. Contamination levels must be kept low to prevent the introduction of ions that, in combination with moisture vapor, generate corrosion, pitting and/or transistor inversion. Extreme cleanliness is required during the shipping of the semiconductor wafers. Similarly, mechanical protection of the semiconductor wafers during transportation can be problematic if the wafer container is not completely full.

OBJECTS AND SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a cushion-like element for the transportation of semiconductor wafers which maintains the low contamination levels required for such transportation.

It is therefore a further object of the present invention to provide a cushion-like element which provides mechanical and electrostatic protection to semiconductor wafers during transportation.

These and other objects are attained by providing a cushion with a cylindrical interior formed of closed cell polyethylene foam, typically one quarter to three eighths of an inch thick, with a diameter approximately equal to the diameter of the semiconductor wafers to be transported. A thin outer surface of electrostatic discharge (ESD) dissipative polyethylene is laminated to the polyethylene foam interior by hot melt EVA adhesive. The exterior surface is perforated with small apertures, typically less than 0.010 inches in diameter, to allow for compression upon impact. The ESD dissipative polyethylene is heat wire cut to seal the ends about the periphery of the cushion.

BRIEF DESCRIPTION OF THE DRAWINGS

Further objects and advantages will become apparent from the following description and from the accompanying drawings, wherein:

Figure 1 is a top plan view of the cushion-like device of the present invention.

Figure 2 is a cross-sectional view along plane 2-2 of Figure 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings in detail wherein like numerals indicate like elements throughout the several views, one sees that Figure 1 is a top plan view of the cushion-like device 10 of the present invention. The cushion-like device 10 is symmetric so that Figure 1 could likewise be a bottom view. Device 10 is cylindrically shaped with a diameter approximately equal to the diameter (typical diameters include, but are not limited to, eight or twelve inches) of the semiconductor wafers to be transported. As shown in Figure 2 the interior of device 10 is formed by a shallow cylindrically shaped portion 12 of polyethylene closed cell foam which is typically neither treated nor dyed. The closed cell foam of portion 12 uses a foaming agent that imparts minimal alkanes and cations into the polyethylene foam material. Portion 12 of polyethylene closed cell foam is typically one quarter to three eighths of an inch thick, but those skilled in the art, after review of this disclosure, will recognize that different thicknesses may be appropriate for various applications. The exterior of device 10 is covered with antistatic film (or laminate) 14. Antistatic film 14 is typically Richmond/Valeron® material, such as 1207 LLDPE Lamination Grade Film (86-R0438) which is sold by assignee Illinois Tool Works Inc., using the specification number 86-R0438 which details the formulation and property requirements for this antistatic film. Antistatic film 14 is typically 0.003 inches thick and includes perforations 16 which typically are spaced less than one fourth of an inch apart and have a diameter of 10 mils (0.010 inches). This allows compression of portion 12 of polyethylene closed cell foam while maintaining the required clean environment around device 10. Antistatic film 14 is secured to portion 12 of polyethylene closed cell foam by a laminating glue which is a hot melt EVA material that is likewise substantially free of cations and alkenes and is highly compatible to polyethylene materials. As shown in Figure 2, the antistatic film 14 is cut and heat sealed around

the edges to form circular peripheral seam 18 thereby minimizing particulation of the foam upon aging. The antistatic film 14 typically provides electrostatic dissipative characteristics to both sides of portion 12 of polyethylene closed cell foam at low voltages, such as ten volts.

The cushion-like device 10 is designed to generate contamination levels below 50 ppm (leachable alkanes, anions, halogens, ammonias or cations) as detected through leach testing at 60° and 90° Centigrade testing at one hour soak durations, as well as organic and inorganic analysis. The low organic/inorganic and acid compound material contamination reduces ion contamination, pitting and corrosion on tight geometry 90 nanometer (and below) semiconductor wafers during shipping.

In order to use cushion-like device 10, the user typically places separators (not shown) between successive semiconductor wafers (not shown). A separator which is particularly well adapted for this application is disclosed in U.S. provisional application serial no. _____, filed on July 13, 2004, entitled "Scribed Interleaf Separator Wafer Packaging". The cushion-like device 10 is placed at one or both ends of the stack of semiconductor wafers and separators and the resulting stack is placed into a container adapted for semiconductor wafer transportation. A container which is particularly well adapted for this application is disclosed in PCT/US04/14659, filed on May 10, 2004, entitled "Wafer Box with Radially Pivoting Latch Elements". The appropriate number and thickness of cushion-like devices 10 are chosen so that the semiconductor wafers are mechanically constrained within the container.

Thus the several aforementioned objects and advantages are most effectively attained. Although a single preferred embodiment of the invention has been disclosed and described in detail herein, it should be understood that this invention is in no sense limited thereby and its scope is to be determined by that of the appended claims.

CLAIMSWhat is Claimed is:

1. A device for cushioning semiconductor wafers, comprising:
a foam interior; and
a film surrounding said foam interior, said film having antistatic characteristics and apertures to allow for compression of said foam interior upon impact.
2. The device of Claim 1 wherein said foam interior comprises closed cell polyethylene foam.
3. The device of Claim 2 wherein said closed cell polyethylene foam utilizes a foaming agent which imparts minimal alkanes and cations to said closed cell polyethylene foam.
4. The device of Claim 1 wherein said foam interior is cylindrical with a thickness substantially in the range of one quarter to three eighths of an inch thick.
5. The device of Claim 1 wherein said film is secured to said foam interior by hot melt material which is substantially free of cations and alkanes.
6. The device of Claim 1 wherein said film is an electrostatic dissipative polyethylene.

7. The device of Claim 6 wherein said film is approximately 0.003 inches thick.
8. The device of Claim 7 wherein said apertures are approximately 0.010 inches in diameter and are spaced less than 0.25 inches apart.
9. The device of Claim 1 wherein said film includes a plurality of pieces which are joined together by a seam formed by heat sealing.

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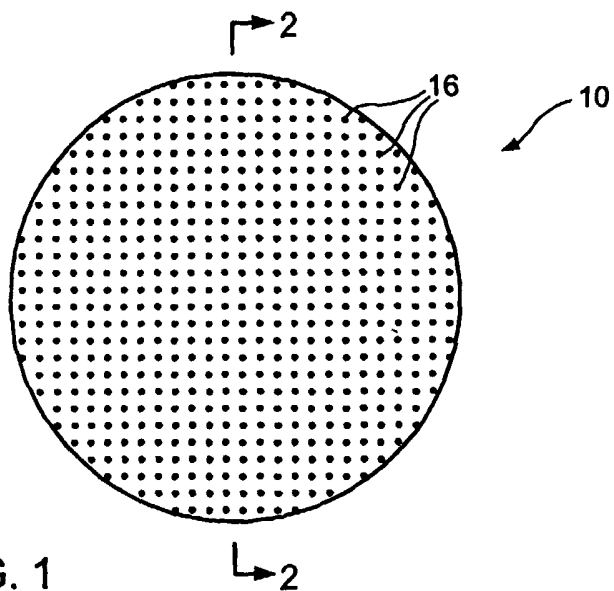


FIG. 1

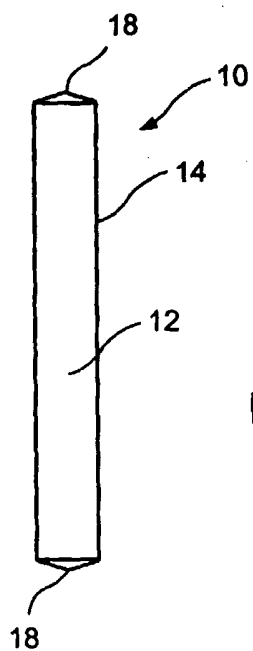


FIG. 2

INTERNATIONAL SEARCH REPORT

International application No.

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A. CLASSIFICATION OF SUBJECT MATTER IPC(7) : B32B 3/24, 3/26; B65D 85/00, 85/48 US CL : 428/138, 318.4; 206/710 According to International Patent Classification (IPC) or to both national classification and IPC																	
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) U.S. : 428/138, 318.4, 319.3, 319.7, 319.9; 206/710,523 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) East USPGPUB & USPAT: (electrostatic or static) near5 film and (cushion or foam) and wafer																	
C. DOCUMENTS CONSIDERED TO BE RELEVANT <table border="1"> <thead> <tr> <th>Category *</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>X</td> <td>US 6,286,684 B1 (BROOKS et al.) 11 September 2001 (11.09.2001), abstract, col. 4, lines 45-65, col. 5, line 65 to col 6, line 20.</td> <td>1, 6-7 and 9</td> </tr> <tr> <td>---</td> <td></td> <td>-----</td> </tr> <tr> <td>Y</td> <td></td> <td>2-5 and 8</td> </tr> <tr> <td>Y</td> <td>US 2003/0066780 A1 (ZABKA et al.) 10 APRIL 2003 (10.04.2003), abstract.</td> <td>2-3</td> </tr> </tbody> </table>			Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	X	US 6,286,684 B1 (BROOKS et al.) 11 September 2001 (11.09.2001), abstract, col. 4, lines 45-65, col. 5, line 65 to col 6, line 20.	1, 6-7 and 9	---		-----	Y		2-5 and 8	Y	US 2003/0066780 A1 (ZABKA et al.) 10 APRIL 2003 (10.04.2003), abstract.	2-3
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☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.																	
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