477 g of cyclohexanone, and the solution was filtered through a polyethylene microfilter with a pore diameter of 0.2 μm to prepare a solution of peeling layer-forming composition 4 for use in laser debonding.

[0131] (Peeling Layer-Forming Composition 5)

60 g of the polymer obtained in Synthesis Example 1 (PCzNA) was dissolved in 849 g of propylene glycol monomethyl ether acetate, and the solution was filtered through a polyethylene microfilter with a pore diameter of 0.2 μm to prepare a solution of peeling layer-forming composition 5 for use in laser debonding.

[0132] (Peeling Layer-Forming Composition 6)

With 9.2 g of the polymer obtained in Synthesis Example 1 (PCzNA), 0.4 g of tetramethoxymethyl glycoluril as a crosslinker, 0.04 g of pyridinium p-toluenesulfonate as an acid catalyst, and 3 mg of R-30N (available from Dainippon Ink and Chemicals, Inc.) as a surfactant were mixed, and the mixture was dissolved in 15.3 g of propylene glycol monomethyl ether acetate, 7.2 g of propylene glycol monomethyl ether, and 7.2 g of cyclohexanone to obtain a solution. Subsequently, the solution was filtered through a polyethylene microfilter with a pore diameter of 0.2 μm to prepare a solution of peeling layer-forming composition 6 for use in laser debonding.

[0133] (Peeling Layer-Forming Composition 7)

With 2.0 g of the resin obtained in Synthesis Example 3 (PCzNP), 0.006 g of R-30N (available from Dainippon Ink and Chemicals, Inc.) as a surfactant was mixed, and the mixture was dissolved in 3.97 g of propylene glycol monomethyl ether acetate, 2.16 g of propylene glycol monomethyl ether, and 18.84 g of cyclohexanone to obtain a solution. Subsequently, the solution was filtered through a polyethylene microfilter with a pore diameter of 0.2 μm to prepare a solution of peeling layer-forming composition 7 for use in laser debonding.

[0134] (Peeling Layer-Forming Composition 8)

With 1.0 g of the polymer compound obtained in Synthesis Example 4 (PCzHDC), 0.2 g of tetramethoxymethyl glycoluril as a crosslinker, 0.02 g of pyridinium p-toluenesulfonate as an acid catalyst, 0.003 g of R-30N (trade name, available from

peeling properties of the glass wafer were confirmed. A case where easy peeling is possible is represented by "○," and a case where peeling is impossible is represented by "×." The results are shown in Table 11.

[0173]

Table 11 Laser Debonding Test Using 12-inch Wafer

	Kind of wafer on device side	Optimal irradiation dose [mJ/cm^2]	Peeling Properties
Example (10-1)	Silicon wafer	150	○
Example (10-2)	Cu pillar wafer	150	○
Example (10-3)	Cu pillar wafer	150	○
Example (10-4)	Cu pillar wafer	150	○

[0174] It was confirmed that the carrier wafer was easily peeled after laser irradiation. In a case of using the TEG wafer, it was also confirmed that the wafer was peeled with good reproducibility.

[0175] (Example 11) Verification of Tape Peeling (Tearing Adhesion Layer off) after Debonding (Peeling) by Laser Irradiation

To a 301-mm glass wafer (EAGLE-XG, available from Corning Incorporated, thickness: 700 μm) as a wafer (support) on a carrier side, the peeling layer-forming composition (6) was applied by a spin coater (Delta 12RC, manufactured by SUSS MicroTec KK), and heated on a hot plate at a temperature of 250°C for 1 minute to form a peeling layer (6). As a wafer having no construction for a wafer on a device side, a silicon wafer was used, and as a TEG wafer, a Cu pillar 300-mm wafer (thickness: 770 μm, chip size: 10 mm, Cu pillar diameter: 40 μm, Cu pillar height: 25 μm, bump pitch: 100 μm, substrate: SiN) manufactured by KIYOKAWA Plating Industry Co., Ltd., was used. To each of the wafers, the adhesive A was applied by a spin coater (XBS300 manufactured by SUSS MicroTec KK), and heated at 120°C for 1 minute to form an adhesion layer A. The 301-mm glass wafer having the peeling layer (wafer on the carrier side) produced in advance was bonded to the wafer on the device side so that the peeling layer and the adhesion layer A were disposed between the wafers in a vacuum bonder (XBS300, manufactured by SUSS MicroTec KK). Thus, a laminated body was produced. Subsequently, the laminated body was heated on a hot plate at 200°C for 10

minutes, to cure the adhesion layer A. The wafer on the device side of the obtained laminated body was made thin to 50 μm by a high rigid grinder (HRG300 manufactured by TOKYO SEIMITSU CO., LTD.). After then, the laminated body was subjected to a high temperature treatment in an oven at a temperature of 250°C for 1 hour, and then mounted on a dicing tape (DU-300, available from Nitto Denko Corporation). The whole surface of the wafer was irradiated with a laser having a wavelength of 308 nm by a laser irradiation device (Lambda SX manufactured by Coherent, Inc.) from a side of the glass wafer at an irradiation dose of 150 mJ/cm^2, and the glass wafer was peeled. A temporary adhesion layer formed by the adhesive A remained on the device side and the peeling layer were torn off through a tape peeling method using a peeling tape (DLO330MA available from Microcontrol electronic SRL) and a tape peeling device (DT300 manufactured by SUSS MicroTec KK) at a range of 60 to 180°, and the temporary adhesion layer was separated from the wafer on the device side. A case where no residue thereof remains on the wafer after separation by tape peeling is evaluated as "○," and a case where a residue thereof remains on the wafer after separation by tape peeling is evaluated as "×." The results are shown in Table 12.

[0176]

Table 12 Verification of Tape Peeling

	Kind of wafer on device side	Tape peeling properties
Example (11-1)	Silicon wafer	○
Example (11-2)	Cu pillar wafer	○
Example (11-3)	Cu pillar wafer	○
Example (11-4)	Cu pillar wafer	○

[0177] (Example 12) Measurement of Transmittance of Peeling Layer

Each of the peeling layer-forming compositions was applied to a quartz substrate by a spin coater, and heated on a hot plate at 250°C for 1 minute, at 250°C for 5 minutes, at 300°C for 2 minutes, at 350°C for 2 minutes, or at 400°C for 2 minutes, to form a peeling layer (film thickness: 0.2 μm). In order to judge whether the peeling layers could be used as a peeling layer for laser debonding, the transmittances of the peeling layers to light having a wavelength of 532 nm were measured by an ultraviolet-visible

coater, and heated at 120°C for 1 minute to form an adhesion layer A. The glass wafer having the laser peeling layer (wafer on the carrier side) produced in advance was bonded to the wafer on the device side so that the peeling layer and the adhesion layer A were disposed between the wafers in a vacuum bonder (manual bonder, manufactured by SUSS MicroTec KK). Thus, a laminated body was produced. Subsequently, the laminated body was heated on a hot plate at 200°C for 10 minutes with the wafer on the device side disposed downwardly, to cure the adhesion layer A. The whole surface of the wafer was irradiated with a laser having a wavelength of 532 nm by a laser irradiation device (LT-2137 manufactured by Lotus-TII) from a side of the glass wafer, and the glass wafer was peeled. A temporary adhesion layer formed by the adhesive A remained on the device side and the peeling layer were torn off using a peeling tape (N300 available from Nitto Denko Corporation), and the temporary adhesion layer was separated from the wafer on the device side. A case where no residue thereof remains on the wafer after separation by tape peeling is evaluated as "○," and a case where a residue thereof remains on the wafer after separation by tape peeling is evaluated as "×." The results are shown in Table 17.

[0191]

Table 17 Verification of Tape Peeling

	Heating temperature [°C]	Heating time [minute]	Optimal irradiation dose [mJ/cm^2]	Tape peeling properties
Peeling layer (9)	400	2	300	○
Peeling layer (10)	350	2	200	○
	400	2	200	○

[0192] (Example 17) Evaluation of Debonding using 12-inch Wafer by Laser Irradiation

To a 301-mm glass wafer (EAGLE-XG, available from Corning Incorporated, thickness: 700 μm) as a wafer (support) on a carrier side, the peeling layer-forming compositions (5), (6), (9), and (10) were applied by a spin coater (Delta 12RC, manufactured by SUSS MicroTec KK), and heated on a hot plate at 200°C or 250°C for 1 minute to form peeling layers (5), (6), (9), and (10). As a wafer on a device side, a silicon wafer was