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Locating and Tracking the Evolution of Debonds at the Interface of Bonded Semiconductor Devices Using Infrared Photoelasticity

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An infrared grey-field polariscope (IR-GFP) was developed as a new tool to reliably detect small defects at bonded interfaces and to distinguish between trapped interfacial defects. The IR-GFP improves upon infrared transmission (IRT) imaging by measuring the stress-fields associated with defects. The IR-GFP was validated using anodically bonded glass-silicon samples followed by imaging interface defects in fusion bonded silicon wafer pairs. Defect maps collected using the IR-GFP were contrasted with defect maps collected using conventional IRT imaging, showing that the IR-GFP has improved defect resolution. In addition, because the IR-GFP measures the defect stress field, it can distinguish between trapped gas and trapped particle defects. Furthermore, by imaging the residual stress signature associated with defects, the IR-GFP can detect defects smaller than the wavelength of the transmitted near IR (1.1 micron). Finally, utilizing the residual stress signature associated with trapped gas defects, the IR-GFP was used to track the evolution of time-dependent gas bubbles during annealing of fusion-bonded wafer pairs.

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