LASER SCRIBING ON SOI WAFER

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The light with the wavelength of 1.06 μm (1.17 eV) from Nd:YAG laser is used for silicon wafer laser scribing. The energy of the light is close to the indirect silicon bandgap and due to low absorption in this region the penetration depth of light into the wafer is relatively high. On the other hand, light absorption is increasing with increasing temperature; light is absorbed and creates well defined deep holes with edge slag rings in silicon. These 'points' create text for wafer marking (see Fig. 1).

We observed decreased scribe depth and diameter of holes at SOI wafer edge, where light interference fringes are seen (Fig. 1). These are indicating a gradient in device layer thickness, which causes laser light reflectivity fluctuations. At a high reflectivity condition the laser scribe is shallower and narrower as at a low reflectivity conditions. Scribe depth and diameter are roughly constant for reflectivity of up to 0.6; but decrease dramatically above 0.6 [1].

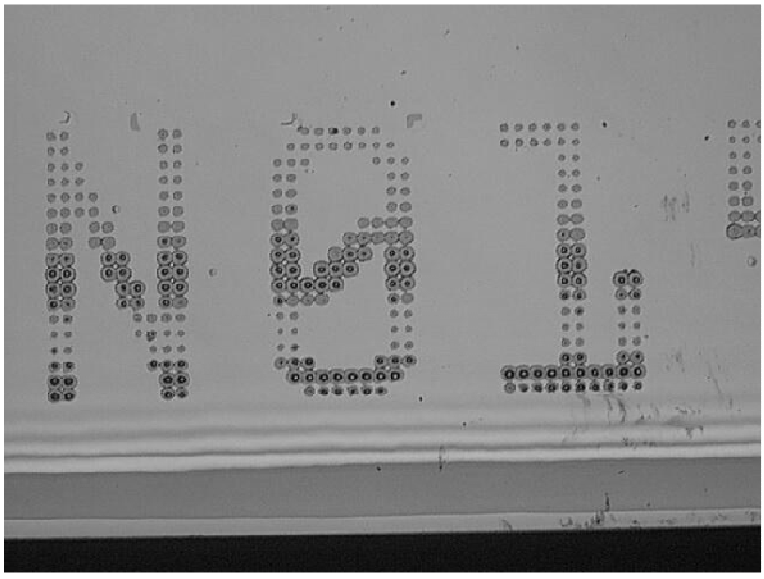

Fig. 1: Example of a laser scribe on SOI wafer. Decreased scribe depth and diameter of holes were observed.

Modeled reflectivity spectrum for SOI with 1 μm buried oxide (BOX) and 3 μm top device layer is in Fig. 2. The feature related to the first direct electronic transition in silicon E_1 at 3.4 eV and starting interferences in device layer when penetration depth of the light approaches first silicon – oxide interface are clearly visible. BOX causes fluctuating interferences (beats) in reflectivity spectrum. The distance between maxima and minima is decreasing with increasing device layer and BOX thickness (see Fig. 2).

We proposed and modeled slight modifications (10% BOX thickness increase and surface oxide layer) of the SOI systems to reduce reflectivity value and its variation and thereby reduce shallow points in the wafer label (Fig. 3).

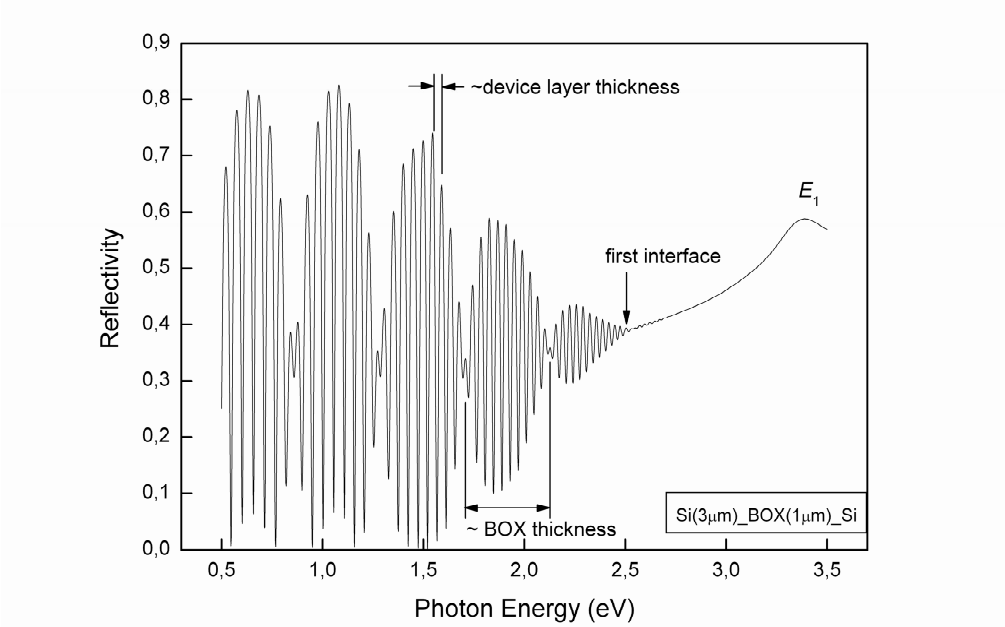

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Fig. 2: Modeled reflectivity spectrum of the SOI with 1 μm BOX and 3 μm device layer.

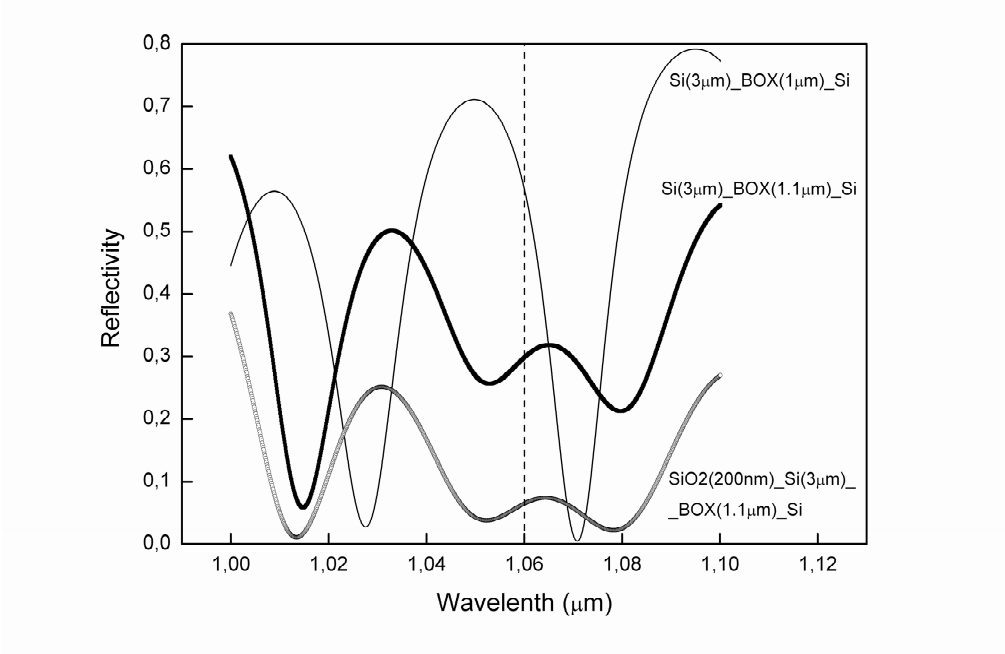

Fig. 3: Reflectivity spectra for SOI systems proposed to reduce reflectivity value and its variation and thereby reduce shallow points in the wafer label.

[1] Source: internal information from Le Laboratoire d'Électronique et de Technologies de l'Information (LETI), Grenoble.