Process and Characterization

The production process for Scint-X structured scintillators is divided into six major steps:

- Oxidation: For the silicon etching step a silicon dioxide mask is required. Thus, a thin top layer of the wafer is oxidized in a furnace with oxygen atmosphere.

- Optical lithography: First resist is spun onto a silicon wafer. This polymer layer is sensitive to ultraviolet light and changes its chemical structure when it is exposed to such illumination. The resist is baked, so its consistency becomes less liquid. Then a chromium mask with a grid pattern is used to expose the resist, just like in photography. After developing the resist with a chemical that removes all exposed parts, a grid is left on the wafer. Another baking step hardens the pattern, so it can be used in the following steps.

- Silicon dioxide etching: As explained before, the pattern created with optical lithography has to be transferred to the silicon dioxide. In a silicon dioxide etching step, the remaining resist pattern is used as a mask for the underlying oxide layer.

- Silicon etching: Either electrochemical or deep reactive ion etching (DRIE) can be used to obtain channels required for Scintillator Matrix Technology. The oxide grid from the former step is used as a mask which protects lines within the pattern from being etched away. Those lines become the channel side walls in the structured scintillator.

- Scintillator filling: In order to give the matrix its function, it has to be filled with scintillator material. After removing the resist residue from the wafer (lift-off), Thallium doped Cesium Iodide (CsI:Tl) is molten into the channels at a few hundred degrees Celsius. During cooldown the scintillator material recrystallizes.

- Passivation: Since the scintillator material deteriorates slowly when exposed to ambience, a thin passivation layer is brought onto the open channel surface. This layer will later be in contact with the CCD chip. It is transparent for the light emitted by the scintillator material in the channels, but prevents condensing water from decreasing the device quality.

Finally, the wafer has to be diced. There can be numerous Scint-X x-ray detector devices on one wafer, so that the single chips have to be cut out with a dice saw.

Process and Characterization

Subsequent characterization determines properties of interest which enable comparison between the Scint-X product and its competitors. Especially three properties can be interesting for potential users.

- Resolution: In order to determine the resolution, so-called MTF (modulation transfer function) curves are recorded: The contrast is shown as a function of spatial frequency. In other words: Those measurements determine how well line pairs with decreasing distance apart can be observed as distinct features.

- Conversion efficiency: The ratio of output signal to incident x-rays describes how well (or in which amounts) the incoming radiation is converted into visible light.

- Signal quality: The better the signal to noise ratio (SNR), the better the image quality.