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Processing of a structured scintillator for high-resolution X-ray imaging

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Structured scintillators coupled with CCDs are promising devices for digital X-ray imaging. These novel X-ray detectors are made by fabrication of high aspect ratio silicon pores by ICP etching, oxidation of the pore walls and finally melting of thallium doped CsI into the pores. In this type of detectors the oxide layer on the pore walls is utilized as the cladding layer similar to optical fibers to confine the produced visible photons inside the pores after the scintillation process. Furthermore, the remaining silicon layer in the middle of the pore walls absorbs the escaping visible photons, effectively reducing the cross talk between the pores. Hence, in this type of detectors outstanding resolutions are provided by only shrinking the lateral dimensions of the pores. In order to investigate the effect of down scaling on the performance of such devices, different silicon pore arrays with different geometries were fabricated with a smallest pitch of 1.4 μm. Preliminary attempts to optimize the filling parameters were carried out and the performance of the structures regarding X-ray absorption and light yield was evaluated. The results show that, simply increasing the melting time and temperature of the filling process increases the likelihood of the loss of thallium dopant in the pores, reducing the light yield. A comparison of the light yield efficiency of the samples demonstrates that the smaller the pores are the less light yield is gained. Yet, a substantially increased absorption length compared to other non-structured, high resolution scintillators will lead to dramatic improvements in the detection efficiency. Since the fabrication method is still immature, further development of the fabrication method might lead to improved yield while increasing the resolution of the device.

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