High lateral resolution fibered sensor for dosimetry at high energies

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Abstract

X-rays are nowadays essential in the characterization and metrology of materials, objects and living species as well as in cancer therapy. The industrial development of X-ray detectors and cameras is however still hindered by the difficulty to ensure efficient "X-photon"-to-electron conversion in electronic devices needed to reach high signal/noise ratio. Indirect detection technique, which combines scintillators to silicon-based optical detectors, has demonstrated performances in terms of image contrast and signal dynamics, and are now widely developed by many companies. However, problem remains that the resulting sensors and cameras suffer from modest spatial resolution (about 10 µm) and cross-talk between neighboring pixels. Best resolution up to 1.6 microns is achieved with cameras which incorporate expensive and high steric hindrance bulky lens. On the other hand, X-ray detectors and cameras are often too bulky to allow easy manipulation, rapid implementation into systems, and endoscopic for in-vivo applications.
The purpose of our study is to show the feasibility, to design and to test the performances of novel extremely compact and highly sensitive X-ray micro and nano-detectors grafted at the end of single optical fibers [1]. The main idea is to take advantage of a new Nano-Optical Antenna (NOA) for efficiently collecting and transferring X-ray Excited Photoluminescence (XEP) from nanoscintillators towards optical fiber aperture (figure 1), in order to achieve high performance X-ray detectors and cameras available in compact and flexible architectures free from bulky optics and compatible with endoscopy (see fig.1).

References

[1] Z. Xie et al., Optics Letters, Vol. 42(7), 1361-1364 (2017)

Figures

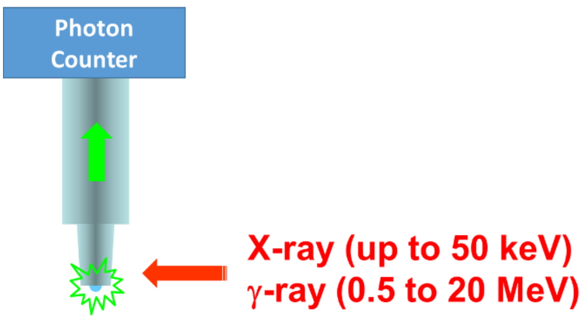

Figure 1. Test bed for simulation results validation