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## X-ray generator: an application of micro pattern gas detector

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We invented an X-ray generator by using gas electron multiplier (GEM) foils combining with the coniferous carbon nano structure (CCNS), and demonstrated that the generator worked properly as we expected. Of course, this is not an usual application of MPGD but one of possibility to expand our field of the MPGD devices.

There is no doubt about the importance of X-ray generators in recent world, e.g. in commercial, industrial, and scientific applications. To fabricate an X-ray generator, an electron source (or an electron gun) is must in place. The X-ray generators usually employ thermally heated cathode as the electron source. Recently, carbon nano tube (CNT), from which we can extract electrons by the field emission, is recognized as one of candidates of the electron sources.

We have employed the coniferous carbon nano structure (CCNS) as the field emission device, in which CNT roots to a substrate through some bulky structures of carbon nano wall and nano diamond, forming tight connection between CNT and substrate. We just put our GEM foil onto the CCNS substrate in vacuum and applied the gate voltage to the GEM electrodes. Thanks to the thinness of the GEM foil, the CCNS+GEM device becomes an efficient electron emitter working with a low ( $< 100V$ ) gate voltage. The emitted electrons are guided to and bombarded on a target metal, and then characteristic and bremsstrahlung X-rays are emitted.

We can turn on and off the generator quickly ( $< 1$  us) by switching the gate voltage; it is not necessary to switch the high voltage applied to the target metal. The X-ray generator can issue trigger timing signals, i.e. the generator can emit X-rays with synchronous to the data acquisition timing of a detector system. This character implies that the generator becomes a good calibration device which we can operate during any experiments.

We will present the design and performance of the X-ray generator at the conference, and show some industrial applications, for example, the flat X-ray source for CT scan devices.

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