EFOMP COMPANY MEMBER ARTICLE

PTW microDiamond® - A Decade of Measuring Small Fields

PTW THE DOSIMETRY COMPANY

On August 30th, 2013, PTW introduced its famous microDiamond detector (T60019) to the market. Within no time, the new diamond detector developed into one of the most successful and popular PTW detectors. This year, we are celebrating its tenth anniversary.

It all began with a "Contact" button

In July 2007, Professor Marco Marinelli from Tor Vergata University of Rome hit the "Contact" button on our website, asking us if we were interested in a CVD diamond detector developed by his working group. Our interest was sparked, and we decided to learn more.

In the following years, a lot of microDiamond prototypes changed hands between PTW in Freiburg and Marco Marinelli and Gianluca Verona Rinati from Tor Vergata University in Rome. Over time, the prototypes became more refined and improved from quite good to excellent. Finally, after five years of development and testing, they were ready to go into serial production. The microDiamond was born.

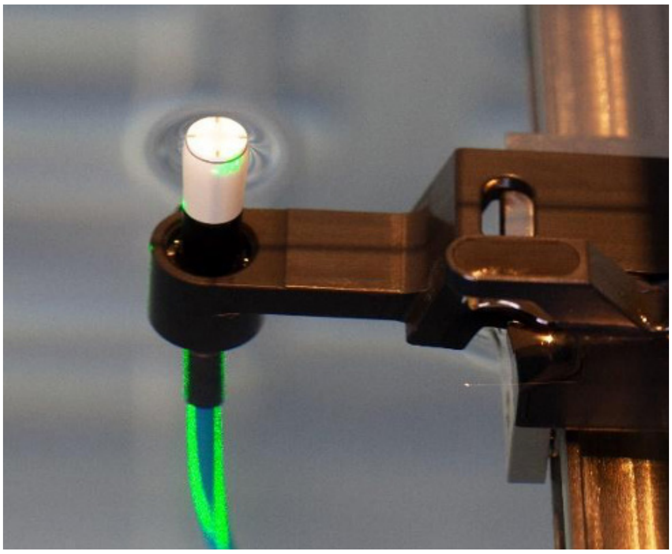

Figure 1: Stable as a diamond, sensitive as a diode – the microDiamond detector is the ideal detector for a broad range of radiotherapy applications.

What makes the microDiamond so special?

You might be wondering what makes the microDiamond such a successful detector. It is a combination of its unique properties:

It is water-equivalent: The atomic number of carbon, Z=6, is very close to the effective atomic number of water (combination of 2x hydrogen, Z=1, and oxygen, Z=8).

It is versatile: In contrast to silicon detectors, no shielding is required for measurements in large photon fields. The microDiamond can be used in all photon field sizes, basically under any condition and at any position within the water phantom. In addition, it can be used for the dosimetry of electron, proton, and carbon ion beams, and for many brachytherapy measurements. And according to the latest results, it even seems to be suitable for proton FLASH beams.

Its response is fully stable with accumulated dose: There is no need for repeated cross-calibration.

Its dose-rate dependence is negligible: For classical and FFF photon beams, it is smaller than the measurement uncertainty.

It is for small fields: The microDiamond detector has correction factors very close to 1.0 for small-field measurements (see small-field correction factors published in IAEA TRS-483, Fig. 2).

It is well designed: Due to the 2.2 mm diameter of the sensitive volume, the microDiamond exhibits a weak dose-volume effect. This is important because it also features a high density of 3.5 g/cm³. Volume effects and density perturbations compensate each other almost perfectly. This is the reason why the small-field correction factors are so close to 1.0 (see Fig. 2), and why the microDiamond can be used down to the smallest field size defined in IAEA TRS-483 (0.4 cm). [1]

It is well characterized: The microDiamond is one of the most studied small-field detectors. The Journal Medical Physics alone lists 145 articles that contain the keywords "microDiamond" and "PTW" [checked at https://aapm.onlinelibrary.wiley.com/journal/24734209 on 2023-07-21].

Until today, the microDiamond detector has been used for virtually any dosimetry task you can imagine, ranging from linac commissioning, giving quite accurate penumbras, to the dosimetry of electrons [2], protons [3], and carbon ions [4], or orthovoltage dosimetry [5]. It has even been used for electronic [6] and classical brachytherapy applications [7].

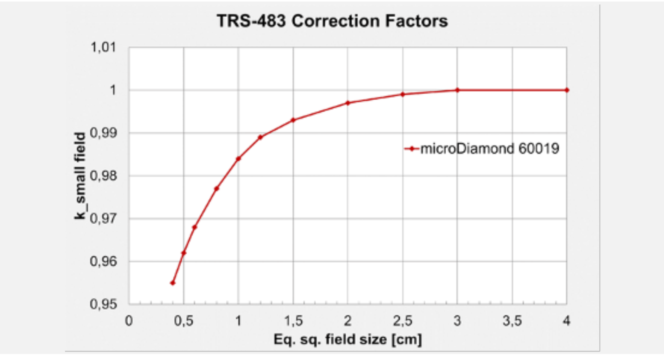

Figure 2: With correction factors very close to 1.0, the microDiamond is suitable for accurate small-field dosimetry down to the smallest field size defined in IAEA TRS-483

After ten successful years, the microDiamond has now paved the way for the flashDiamond. Look out for this new detector, specially designed for the tough conditions of electron FLASH dosimetry.

Happy birthday and congratulations, microDiamond! You have become one of the most popular small-field detectors of all time worldwide. May your success continue to grow for the next decades.

For more information on microDiamond visit https://www.ptwdosimetry.com/en/products/microdiamond.

References:

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