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Development of Micro and Nano Crystalline CVD Diamond TL/OSL Radiation Detectors for Clinical Applications[1]

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Modern radiotherapy methods requires the use of high photon radiation doses delivered in a fraction to small volumes of cancer tumors. An accurate dose assessment for highly energetic small x-ray beams in small areas, as in stereotactic radiotherapy, is necessary to avoid damage to healthy tissue surrounding the tumor. Recent advances on the controlled synthesis of CVD diamond have demonstrated the possibility of using high quality micro and nano crystalline CVD as an efficient detector and dosimeter suitable for high energy photons and energetic particle beams. CVD diamond is a very attractive material for applications in ionizing radiation dosimetry, particularly in the biomedical field since the radiation absorption by a CVD diamond is very close to that of soft tissue. Furthermore, diamond is stable, non-toxic and radiation hard. In the present work we discuss the CVD diamond properties and dosimeter performance and discuss its relevance and advantages of various dosimetry methods, including thermally stimulated luminescence (TL) as well as optically stimulated luminescence (OSL). The recent CVD improved method of growth allows introducing precisely controlled impurities into diamond to provide it with high dosimetry sensitivity. For clinical dosimetry applications, high accuracy of dose measurements, low fading, high sensitivity, good reproducibility and linear dose response characteristics are very important parameters which all are found in CVD diamonds specimens. In some cases, dose linearity and reproducibility in CVD diamond have been found to be higher than standard commercial TLD materials like LiF. In the present work, we discuss the state-of-the art developments in dosimetry applications using CVD diamond.

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