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Developments towards the stand-off detection of alpha emitting materials in daylight through the use of a UVTRON flame sensor.

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Several isotopes of natural and man-made radioactive materials give off only alpha radiation, and although easily stopped by skin, ingestion of alpha particles is most hazardous to humans. It is, therefore, most important that detectors capable of detecting the presence of alpha emitting materials are available for use in the field, either for routine nuclear operations, accidental contamination or for security purposes. The short travel of alpha particles, around 5 cm in air, means that detection via direct interaction with a detector probe makes the process time consuming, makes checking complex morphologies difficult, and may put personnel in close proximity to potentially hazardous radioactive materials. A stand-off alpha detector moves personnel away from any radiation source, reduces scanning time and means that complex surfaces can be more easily checked for alpha contamination. Emitted alpha particles transfer energy to the surrounding atmosphere, causing gas atoms to excite and emit ultraviolet photons. Although the alpha particle itself travels only a few centimetres, these photons travel much further, meaning they can potentially be detected from a distance. They may also be scattered and reflect off surfaces, therefore aiding detection when the alpha source is out of view. In experiments carried out at the National Physical Laboratory (NPL), the ability of a UVTRON sensor (Hamamatsu) to detect photons in the UVC wavelength range (180-280 nm) was established. This wavelength range was used due to the high background from natural and artificial light in the UVA and UVB wavelength range (280-400 nm) which makes alpha-induced radioluminescence difficult to differentiate. The UVTRON has a very low background count in normal laboratory lighting, measured at 2.224 x 10-3 cps average at NPL. The count in the presence of a 6.95 MBq 210Po source was 0.328 cps at 20 mm distance from the sensor. A flow of gas was tested to determine if this would enhance the signal, which was found to be true, with the greatest increase from a flow of xenon which increased the signal by almost 90%, to a count of 0.851 cps. The conclusion of these experiments is that the UVTRON sensor has the potential for use in a detector system which could detect the presence of alpha emitting materials from a distance in normal daylight conditions, and that the use of a gas flow could increase the sensitivity of such a detector system.

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