

Investigation of the Mechanically Induced EPR Signals in Fingernails/Toenails

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Abstract:

Human fingernails and toenails can be used as a dosimeter to measure the magnitude of exposure to ionization radiation. This is based on the use of electron paramagnetic resonance (EPR) for quantification of radicals produced in the nails. However, cutting of nails introduces mechanically induced signals (MIS) that overlap the radiation induced signal (RIS). Moreover, the magnitude of MIS can be comparable to that of the RIS at doses of interest. It therefore is essential to develop methods to account quantitatively for the MIS. This report considers methods to spectroscopically characterize the MIS components and estimate their magnitude by appropriately weighted spectral subtractions. Shortly after cutting, three MIS components can be identified and their time dependence and power saturation behavior have been studied in considerable detail. One component closely resembles the RIS, being a readily saturated by microwave power above .5 mW in a typical X-Band EPR spectrometer and having a symmetrical shape centered near $g=2.00$. MIS-2 has a complex spectrum that includes components at higher g factors and this signal does not power saturate over a broad range of microwave power. The third component (MIS-3) resembles MIS 1 and RIS except that it decays rapidly after being induced by cutting. Because the relative intensities of the three MIS components appear to vary among individuals or conditions of cutting, each sample potentially has a unique shape. However, careful analysis of the properties of each MIS component, especially the power saturation and the spectral shapes and positions, has led to a combination of spectral measurements that can be used to isolate each one by appropriate subtractions of spectra obtained under different microwave intensities and at different times after clipping. This information should make it feasible to measure the RIS in each sample.

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