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Reduction of background in CDBS spectrometer: An analytical review of the hyperbolic positron spectrum

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Abstract

In this study, in order to reduce the background spectrum in Doppler broadening spectroscopy and, to use information about the tail of spectrum, which is mainly due to the annihilation of positrons by core electrons, a new setup was introduced and the results has been analyzed by the relativity formula. The results show that after the positron enters the sample and is annihilated by the valance and core electrons of the lattice structure, in addition to the two main gamma rays, unwanted gammas caused by the Compton phenomenon and their annihilation outside the sample. In a Doppler broadening spectroscopy, the electrons' energy band information disappears from the researchers' view due to the overlap of the main spectrum with the background spectrum. This extra and unwanted background spectrum wastes a lot of time and energy in studying the structure of materials with the help of this spectrometer. To solve this problem, our research team has developed a new laboratory layout plan after detailed studies, which in addition to reducing the count of unwanted gammas, has also significantly reduced the recording time of the spectrum. The results of this new spectroscopic method compared to the traditional method show a significant reduction in the recording of unwanted gammas and, as a result, a significant increase in the detection of 99% of gammas due to the annihilation of positrons by core electrons.

Keywords: CDBS positron spectrometer, energy band of electron's core, Compton phenomenon, background spectrum

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