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The accumulation effect in positron implantation profiles and annihilation characteristics

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The implantation of energy positrons into the matter is rarely considered in positron annihilation spectroscopy because it is based on the annihilation of thermalized positrons.
However, in the case of a medium that exhibits inhomogeneity, the implantation process may affect the measured annihilation characteristics, for example, positron lifetime spectrum or Doppler broadening of annihilation line. Our latest theoretical and experimental investigations of implantation profiles in stacks of various metallic foils revealed a characteristic accumulation of positrons in a film of denser metal. This effect seems to be obvious because differences in the linear absorption coefficient values cause specific segregation of positrons, they are accumulated in a denser region. This leads the fraction of positrons that annihilate in the denser region is higher than its fractional volume. This effect was clearly demonstrated in the case of epoxy resin samples with embedded heavy metal microparticles. Monte Carlo simulations supported experimental dependencies.

Our recent studies have shown that the effect of accumulation depends on the size of particles deposited in the medium. This suggests that also the diffusion of thermilized positons plays a role in the effect of accumulation, certainly when the particles have a diameter of a nanometer. A model of diffusion of positrons with the accumulation effect will be presented. Its predictions will be discussed.

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