Production of low energy electrons and hydroxyl radicals by heavy ions.

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The production of low energy electrons during the radiolysis of aqueous system with heavy ions is modeled using stochastic simulation methods. The results of these calculations are used to investigate the radiation chemistry of the hydroxyl radical in aqueous solutions of hydroxyl radical scavengers. The track structure simulations follow the attenuation of the radiation particle and ejected secondary electrons collision-to-collision. The calculations are performed with cross-sections appropriate for the interaction of the radiation particle and secondary electrons with liquid water and amorphous solid water so as to accurately predict the radiolysis of a condensed phase system. The diffusion-kinetic evolution of the radiation tracks is modeled using the independent reaction times (IRT) technique. This method is based upon the independent pairs approximation inherent in the Scholuchowski-Noyes treatment of kinetics. Comparison of the predictions of the diffusion-kinetic modeling with experiments shows good quantitative agreement for ^{1}H, ^{4}He, and ^{12}C ions as well as γ-rays. Analysis of the track structure simulations demonstrates that low energy electrons play a major role in determining the (local) radiation track structure and hence are a fundamental determinant of the radiation chemical kinetics observed.

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