NEW MODEL SYSTEM IN RADIATION CRYOCHEMISTRY: HYPERQUENCHED GLASSY WATER

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Since the radical generated by high-energy irradiation of liquid water are short-lived at ambient temperature, they are often studied at cryogenic temperatures after irradiating either crystalline ice or highly concentrated aqueous electrolyte solution glasses. While these studies provided a wealth of information, they also bear disadvantages in that further reactions of these radicals may not be those occurring in liquid water because of formation of other radicals from the solute in the case of the electrolyte solution glass and/or perturbation of the water structure by the solute. Furthermore, in slow-cooled aqueous solutions where ice is formed and phase separation of the solute occurs, the radicals trapped in the ice compartments are unable to interact with solutes because these are dissolved in the 'freeze-concentration" regions. These problems can in principle be overcome by investigating water and dilute aqueous solutions in their glassy states which can be obtained by rapid quenching of the liquids. Glassy water can now routinely be made[1] in gram-quantities by so-called "hyperquenching" of micrometer-sized water droplets on a solid cryoplate. The cooling rates are of the order of 10^6 - 10^7 K s^{-1}. Our results show that indeed in the hyperquenched dilute aqueous solutions there is no problem with phase separation and radiolysis of hyperquenched water is quite distinct from radiolysis of polycrystalline ice obtained from liquid water quenched in the liquid nitrogen[2].

1. E. Mayer, Cryo-Lett. **9**, 66 (1988).
2. J. Bednarek, A. Plonka, A. Hallbrucker, E. Mayer, M. C. R. Symons, J. Am. Chem. Soc. **118**, 9387 (1996).