

Electron-DNA interaction in the presence of copper ion: comparison with iron ion case

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Synopsis Combined effect of low-energy electron interaction and copper ion on DNA damage has been studied. And it has been compared with the previous study on iron ion.

For last a couple of decades, there have been the studies on the damages of biomolecules by low-energy electrons (LEEs) [1]. However, DNA in a real complex cell environment is surrounded by many other molecules like proteins, *metal ions*, and water molecules and interacts with these molecules. Therefore, it is necessary to consider the effects of the molecules surrounding DNA or DNA components when considering DNA damage by LEEs or by high energy radiations.

Metal ions, such as copper and iron, play an important role in reactive oxygen species generation from various carcinogens, leading to DNA damage. Many researchers have performed experiments with DNA-metal ion complex to investigate only the effects of metal ions on DNA damage; no electron irradiation.

Motivated by the possible *combined effects of LEE-irradiation and metal ions*, these authors, for the first time, had previously reported that DNA damages such as single-strand break or double strand break was *significantly enhanced* by LEE interactions in the presence of Fe ion [2].

In this presentation, we have studied the similar effects for the case of copper ion (Cu^{2+}) as a part of continuing studies. First, we have measured the DNA damage for the copper-ion concentrations at the same level as iron-ion case (Fig. 1). pBR322 plasmid DNA films with copper-ion concentrations of 1~7 mM were prepared by lyophilization technique and irradiated by electrons with 10 eV under ultra-high vacuum condition. DNA damage and the effects of copper ion on the damage by low energy electron collision were analyzed by 1 % agarose gel electrophoresis. The result is somewhat different from that of iron ion in Fig 2. In the Conference, we will present the more measurements at a few different electron energies and at the vari-

ous concentrations of copper ion, and will attempt to analyze the differences in the mechanism of iron-ion and copper-ion in DNA damage.

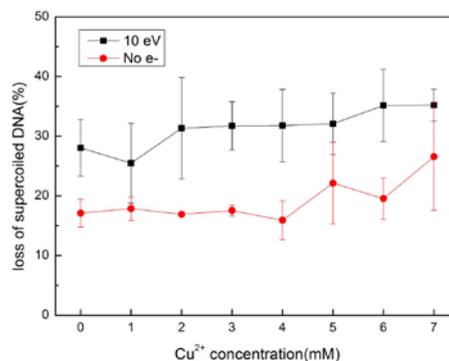


Figure 1. Loss of supercoiled DNA by Cu ion and LEE irradiation

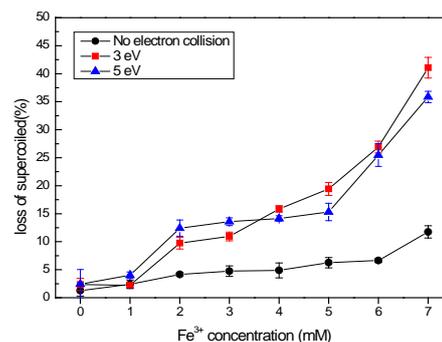


Figure 2. Loss of supercoiled DNA by the combined effects of Fe ion and LEE irradiation [2]

References

- [1] B. Boudaiffa *et al* 2000 *Science* **287** 1658
- [2] Y.S. Park, H. A. Noh and H. Cho 2012 *Radiat. Res.* **177** 775

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