Comparison of DNA damage by sub-ionized and ionized energy electron collisions and novel component separable nonthermal atmospheric plasma

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Abstract: Low energy electrons (LEEs) under 15 eV can indirectly damage DNA subunits via dissociative electron attachment (DEA). We have compared DNA damage induced by LEE and high energy electron (HEE) collisions. We have also tried XPS analysis to clearly interpret the exact mechanism of DNA damage by LEE. Finally, we introduce a new design of nonthermal atmospheric plasma source to investigate plasma effects of plasma agriculture and food applications.

Keywords: DNA damage, dissociative electron attachment, plasma jet, XPS analysis

1. Introduction
It is very interesting that LEE can generate DNA damage by resonant mechanism even they have not enough energy to cause direct ionization [1]. We have studied the exact damage mechanism by LEE and other causes like UV, radical and ions at the molecular level. We will introduce some results and would like to discuss them with you to further understand. And we are planning to make a new experimental system to investigate plasma effects of plasma based agriculture and food applications.

2. Experiment
The dried DNA films through the lyophilized technique were irradiated by LEE (1 eV and 10 eV) and HEE (10 keV) under ultra-high vacuum. And then, the irradiated DNA samples were analysed with HPLC, LC MS/MS and XPS to compare the yield of DNA damage and find out new types of DNA damage.

3. Results and discussion
We confirm that LEEs can indirectly generate DNA damage through DEA resonant process and HEE can directly generate DNA damage through one electron ionization. Fig. 1 shows HPLC chromatogram of 1 eV electron collision on DNA and (2) control.

Fig. 1. HPLC chromatograms of (1) 1 eV electron collision on DNA and (2) control.

Fig. 2. XPS spectra of C1s region for DNA film samples: (a) DNA without LEE and Fe ion; (b) DNA with LEE only; (c) DNA without LEE and with Fe ion; and (d) DNA with LEE and Fe ion.
4. Conclusion

We have compared DNA damage by LEE and HEE collisions. And we also tried XPS analysis of DNA damage to further investigate of DNA damaging mechanism. We introduce a novel component separable nonthermal atmospheric plasma source.

5. References