

PAPER • OPEN ACCESS

Electron ionization and low energy electron attachment to molecules of biological interest

To cite this article: M A Śmiątek *et al* 2015 *J. Phys.: Conf. Ser.* **635** 072025

View the [article online](#) for updates and enhancements.

You may also like

- [VORTEX FORMATION AND EVOLUTION IN PLANET HARBORING DISKS UNDER THERMAL RELAXATION](#)

Aiara Lobo Gomes, Hubert Klahr, Ana Lucia Uribe *et al.*

- [An institutional approach to vulnerability: evidence from natural hazard management in Europe](#)

M Papatoma-Köhle, T Thaler and S Fuchs

- [Climate-induced stressors to peace: a review of recent literature](#)

Ayyoob Sharifi, Dahlia Simangan, Chui Ying Lee *et al.*

PRIME
PACIFIC RIM MEETING
ON ELECTROCHEMICAL
AND SOLID STATE SCIENCE

HONOLULU, HI
Oct 6-11, 2024

Abstract submission deadline:
April 12, 2024

Learn more and submit!

Joint Meeting of
The Electrochemical Society
•
The Electrochemical Society of Japan
•
Korea Electrochemical Society

Electron ionization and low energy electron attachment to molecules of biological interest

M. A. Śmiałek*^{§1}, K. Tanzer[†], M. Neustetter[†], S. Huber[†], R. Schürmann[‡], I. Bald[‡] and S. Denifl^{†2}

* Gdansk University of Technology, Faculty of Ocean Engineering and Ship Technology, Department of Control and Energy Engineering, G. Narutowicza 11/12, 80-233 Gdansk, Poland

§ The Open University, Faculty of Science, Walton Hall, Milton Keynes MK7 6AA, United Kingdom

† Institute for Ion Physics and Applied Physics and Center of Molecular Biosciences Innsbruck, Leopold Franzens University of Innsbruck, Technikerstr. 25, 6020 Innsbruck, Austria ‡ Institut für Chemie, Universität Potsdam, Karl-Liebknecht-Str. 24-25, D-14476 Potsdam, Germany

Synopsis Ethylenediaminetetraacetic acid (EDTA) and 2-amino-2-(hydroxymethyl)-1,3-propanediol (TRIS) were investigated by electron impact ionization and low energy electron attachment. Both compounds are components of biological buffers and often are used as DNA stabilizers in irradiation studies. Thus it is of a great importance to understand their potential interactions with radiation. Our results revealed that at least one of them, EDTA, may influence the experimental outcomes by O^- and OH^- production upon electron attachment.

Understanding the interactions of various types of radiation with the constituent cellular molecules (DNA in particular) underlay new DNA damage models formulation. Such models should be able to predict not only the patterns of ionizations but also the spectra of damage complexity that different types of radiation can induce in DNA.

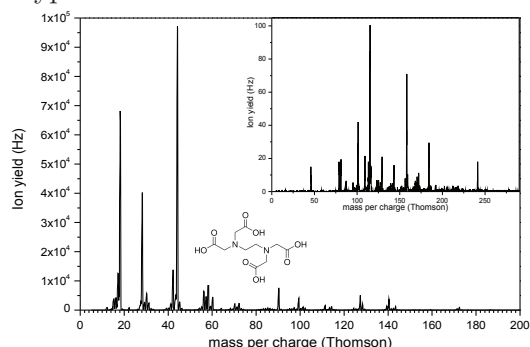


Figure 1. Positive ion mass spectrum of EDTA obtained at 70 eV incident electron energy and negative ions formed upon DEA at 0 eV electron energy (insert)

Hence knowledge of the relationship between the amount of energy deposited within a given region of the DNA helix and the type and severity of the damage that is produced is required [1]. In irradiation studies extracted plasmid DNA is being used that requires stabilisation, e.g. is suspended in EDTA solution. Therefore, the accurate determination of the influence of DNA stabilizers on the experimental outcomes is of great importance [2]. We have investigated by means of 70 eV electron impact and low energy (0-20 eV) electron attachment two most popular compounds used

in DNA irradiation studies; EDTA often used as stabilizer [3] and TRIS used as OH radical scavenger [4], since it has already been noticed that EDTA may impact irradiation outcome [5].

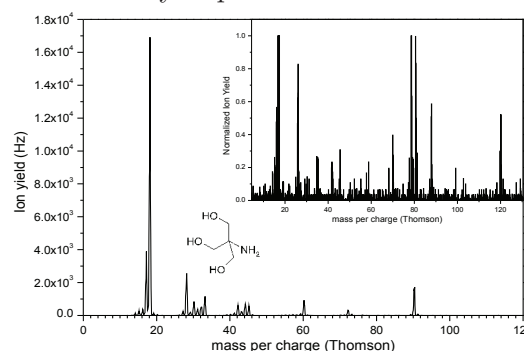


Figure 2. Positive ion mass spectrum obtained at 70 eV incident electron energy and negative ions formed upon DEA over the electron energy range 0-18 eV (insert) of TRIS

Our results indicate that upon LEE attachment as well as at 70 eV electron irradiations vast quantities of charged OH and O are being produced from both compounds. We also derived most probable dissociation channels throughout thermochemical calculations.

References

- [1] M. A. Śmiałek *et al* 2009 *Radiat. Res.* **172** 529
- [2] M. A. Śmiałek *et al* 2010 *Eur. Phys. J. D* **60** 31; 2011 *Eur. Phys. J. D* **62** 197; 2013 *Phys. Rev. E* **87** 060701(R)
- [3] K. M. Prise *et al* 2000 *Int. J. Radiat. Biol.* **76** 881
- [4] M. Folkard *et al* 1999 *J. Phys. B: At. Mol. Opt. Phys.* **32** 2753
- [5] O. Boulanouar *et al* 2013 *J. Chem. Phys.* **139** 055101

¹E-mail: smialek@pg.gda.pl

²E-mail: stephan.denifl@uibk.ac.at

