Tritiated and non tritated ITER-like tungsten particles: from synthesis to genotoxicity

Thierry Orsière*[1], Chiara Uboldi[1], Elodie Bernard[2], Isabelle George[3], Marcos Sanles[4], Stéphane Roche[5], Frédérique Magdinier[5], Bernard Rousseau[3], Gheorghe Dinescu[6], Nathalie Herlin , Tomy Ascente[6], Gregory Pieters[3], Philippe Delaporte[7], Dominique Vrel[8], Jérôme Rose[4], Véronique Malard[9], and Christian Grisolia[10]

[1]Institut méditerranéen de biodiversité et d'écologie marine et continentale (IMBE) – INEE, Université d'Avignon et des Pays de Vaucluse, Institut de recherche pour le développement [IRD] : UMR237, Aix Marseille Université, CNRS : UMR7263, INSB, INSU – Aix Marseille Université, Campus Etoile, Faculté St-Jérôme case 421 Av. . escadrille Normandie-Niemen 13397 MARSEILLE CEDEX 20, France

[2]Laser, Plasmas et Procédés Photoniques (LP3) – Aix-Marseille Université - AMU, CNRS : UMR7341 – Campus Luminy, Aix Marseille Université, Marseille, France

[3]Institut de Biologie et de Technologies de Saclay (IBITECS) – CEA – CEA Saclay bat 532 91191 Gif sur Yvette cedex, France

[4]Centre européen de recherche et d'enseignement de géosciences de l'environnement (CEREGE) – Aix Marseille Université, INSU, Institut de recherche pour le développement [IRD], CNRS : UMR7330 – Europôle Méditerranéen de l'Arbois - Avenue Louis Philibert - BP 80 - 13545 Aix-en-Provence cedex 4, France

[5]Génétique Médicale et Génomique Fonctionnelle (GMGF) – Inserm : U910, Université de la Méditerranée - Aix-Marseille II, Hôpital La Timone, Assistance publique - Hôpitaux de Marseille (AP-HM) – Faculté de Médecine - 27 boulevard Jean Moulin 13385 Marseille Cedex 05, France

[6]National Institute for Laser, Plasma and Radiation Physics (INFLPR) – National Institute for Laser, Plasma and Radiation Physics Str. Atomistilor, Nr. 409 PO Box MG-36, 077125 Magurele, Bucharest, Romania

[7]Laboratoire Lasers, Plasmas et Procédés photoniques (LP3) – CNRS : UMR7341, Université de la Méditerranée - Aix-Marseille II – Case 917 163 Avenue de Luminy 13288 MARSEILLE CEDEX 09, France

[8]Laboratoire des Sciences des Procédés et des Matériaux (LSPM) – Université Sorbonne Paris Cité (USPC), Institut Galilée, université Paris 13, CNRS : UPR3407 – Institut Galilée, Université Paris 13, 99 avenue Jean-baptiste Clément, F-93430 Villetaneuse., France

[9]Laboratoire des Interactions Protéine Métal (LIPM) – CEA – France

[10]Institut de Recherche sur la Fusion par confinement Magnétique (ex DRFC) (IRFM) – CEA – CEA Cadarache, 13108 Saint-Paul-lèz-Durance, France

Abstract

The core of the ITER thermonuclear fusion reactor (www.iter.org) will be made of tungsten, for its mechanical properties and low plasma sputtering yield. Nevertheless, plasma-wall

*Speaker

interaction can trigger the formation of tungsten nanoparticles (W-NP) that can be released in the environment, Assessment of the toxic potentials of W-NP is thus needed.
Genotoxicity of W-NPs of size around 100 nm synthetized by planetary ball milling, plasma and laser abrasion were investigated on BEAS-2B immortalized bronchial cells by using a cytotoxicity kit, the alkaline comet (AC) and the cytokinesis-block micronucleus (CBMN) assays.

The physic-chemical characterization of W-NP showed that plasma and namely laser particles have higher specific surface area than milled ones. W-NP behavior in cell culture media is related to the mode of synthesis.
A time- and concentration-dependent cytotoxic effect was noted, whereas cytostasis was not affected by W-NPs. AC and CBMN assays showed that the primary DNA damage and frequency of micronuclei formation was concentration-dependent and in relation with the mode of production. Genotoxic potential of tritiated plasma W-NP are currently investigated. This type of study will be useful to define the environmental and human health risks in case of release of particles in the environment.

Keywords: Tungsten particle, ITER, genotoxicity, tritium, comet assay, micronucleus assay