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Two-Chamber Configuration of Bio-Nano ECRIS for Fullerene Modification

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Modification of fullerenes, such as encapsulation of alien atom(s) into a fullerene cage, functionalization of the external surface of fullerene molecules, atomic substitution of carbon atom(s) in fullerene molecules, etc., is a key technique for the practical applications of fullerenes. We developed an electron cyclotron resonance ion source (ECRIS) aiming at the modification of fullerenes (Bio-Nano ECRIS) [1]. In a special two-chamber configuration of this ECRIS, two collisional modification processes can be performed simultaneously: a vapor-phase one taking place in the ECR plasma, and a surface-type one formed on the plasma chamber surface.

In this paper, we report on the modification of fullerenes with iron and chlorine using two individually controllable plasmas. One of the plasmas is composed of fullerene and the other one is composed of iron and chlorine. The online ion beam analysis allow to investigate the rate of the vapor-phase collisional modification process, while the offline analyses (e.g. time-of-flight mass spectrometry, liquid chromatography mass spectrometry, etc.) of the materials deposited on the plasma chamber can give information on the surface-type process. Both analytical methods show the presence of modified fullerenes such as fullerene-chlorine, fullerene-iron and fullerene-chlorine-iron, etc.

[1] T. Uchida, et al., Rev. Sci. Instrum. **85**, 02C317 (2014).