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Simulation Study of Optimizing Multicusp Magnetic Line Configurations for a Negative Hydrogen Ion Source

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A multicusp ion source has been used widely in negative hydrogen cyclotrons mainly for radioisotope productions. The ion source is designed to have cusp geometries of magnetic field inside plasma chamber, where ions are confining and their mean lifetimes increase. The magnetic confinement produced a number of permanent magnetic poles helps to increase beam currents and reduce the emittance. Therefore optimizing the number of magnets confining more ions and increasing their mean lifetime in plasma has to be investigated in order to improve the performance of the ion source. In this work a numerical simulation of the magnetic flux density from a number of permanent magnets is carried to optimize the cusp geometries producing the highest plasma density, which is clearly indicated along the full-line cusp geometry. The effect of magnetic fields and a number of poles on the plasma structure are investigated by a computing tool. The electron confinement effect becomes stronger and the density increases with increasing the number of poles. On the contrary, the escape of electrons from the loss cone becomes more frequent as the pole number increases [1]. To understand above observation the electron and ion's trajectories along with different cusp geometries are simulated. The simulation has been shown that the optimized numbers of magnets can improve the ion density and uniformity.

Reference

- [1] Numerical simulation for optimization of multiple permanent magnets of multicusp ion source, M. Hosseinzadeh, and H. Afarideh, *Nuc. Ins. Meth. in Phys. Res. A* 735 (2014) 416.

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Characteristics of Bovine Teeth Whitening in Accordance with Gas Environments of Atmospheric Pressure Nonthermal Plasma Jet

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Currently, teeth whitening method which is applicable to dental surgery is that physician expertises give medical treatment to teeth directly dealt with a high concentration of hydrogen peroxide and carbamide peroxide. If hydrogen peroxide concentration is too high for treatment of maximized teeth whitening effect [1], it is harmful to the human body [2]. To the maximum effective and no harmful teeth whitening effect in a short period of time at home, we have observed the whitening effect using carbamide peroxide (15%) and a low-temperature atmospheric pressure plasma jet which is regulated by the Food and Drug Administration. The gas supplied conditions of the non-thermal atmospheric pressure plasma jet was with the humidified (0.6%) gas in nitrogen or air at gas flow rate of 1000 sccm. Also, the measurement of chemical species from the jet was carried out using the optical emission spectroscopy (OES), the evidence of increased reactive oxygen species compared to non-humidified plasma jet. We have found that the whitening effect of the plasma is very excellent through this experiment, when bovine teeth are treated in carbamide peroxide (15%) and water vapor (0.2 to 1%). The brightness of whitening teeth was increased up to 2 times longer in the CIE chromaticity coordinates. The colorimetric spectrometer (CM-3500d) can measure color degree of whitening effect.

Keywords: teeth whitening, OES, Plasma, carbamide peroxide, CIE chromaticity coordinates, colorimetric spectrometer