CHAPTER 5

CONCLUSIONS

This research has been successfully worked at the Plasma and Clean energy laboratory and Ion beam laboratory, Department of Physics and Materials Science, Faculty of Science, Chiang Mai University and Department of Biology, Faculty of Science, Chiang Mai University. The Bio-plasma jet has been used in the research, made by Photo Bio Care Co. Ltd, Thailand. This chapter is conclusion of the research consisting of the cold atmospheric pressure plasma jet generating energy and power, plasma species (optical emission spectroscopy), changed plasmid DNA form and bacterial mutation.

5.1 Cold atmospheric pressure plasma jet power

This research used the bio-plasma jet which was the cold atmospheric pressure plasma generator, made by Photo Bio Care Co. Ltd, Thailand. This plasma jet generator was for application in skin care clinic. Therefore this research studied about effect of the cold atmospheric pressure plasma on human. This research used bacterial cells to represent human cells.

The result from the previous chapter shows that when the intensity of the plasma is increased on the control panel, plasma is bright up. It could be explained that the intensity of plasma depends on radio – frequency of the generator for creating plasma. And another result shows that the frequency of plasma on the control panel represents the pulse of the plasma output. If both parameters increase, the plasma power increases too.

5.2. Plasma species (optical emission spectroscopy: OES)

Helium gas was used as the initial gas with a flowrate at 600 ml/min. The gas was discharged by the radio frequency inside the plastic nozzle between the needle electrodes. Then, plasma was released to outside through the plastic tube by flowing the gas. This research used OES technique (Optical Emission Spectroscopy) to analyze plasma species. OH, N_2 , N_2^+ , O, O₂ and He radicals were found.

From previous study, the main factor of DNA damage was reactive oxygen species (ROS) and reactive nitrogen species (RNS) which are well known to play an important role in several biological systems. From the OES result, it was concluded that the measured radicals might affect DNA damage.

5.3 Changed plasmid DNA form

Plasmid DNA has 3 forms, supercoiled form, relaxed form and linear form. This research used gel electrophoresis for checking plasmid DNA forms. From the result, it was seen that DNA strand breaks in plasmid DNA were induced by the helium atmospheric pressure plasma jet. Skin-clinic-applied CAPPJ of 100% Helium, even without oxygen or with very negligible oxygen, undoubtedly had effect on treated naked DNA topological form change which in turn could induce possible mutation of living cells. The DNA change was dominated by change of the original supercoiled forms to SSB-caused relaxed forms which were related to the plasma generating power, DSB-caused linear forms were limited due to the low energy character of the CAPPJ. The causes of the DNA change induction might involve charged particles such as ions and electrons, reactive radicals and neutrals. Our study separated these physical agents and found the reactive radicals to be the major inducer of DNA damage when no oxygen was involved.

5.4 Bacterial Mutation

The naked DNA in this thesis is pGFP (plasmid green fluorescent protein). Green fluorescent protein (GFP) is a naturally fluorescent protein first isolated from the jellyfish. The target cells were of *Eschericia coli* (*E. coli*), which were transferred with

naked DNA treated by Cold atmospheric pressure plasma jet. The bacterial plate showed all green light spots except a few white colonies which indicated mutation occurring.

From previous result, reactive oxygen-nitrogen species (RONS) such as nitrogen radical (N_2), superoxide radicals (O_2) and hydroxyl radical (OH) are produced by Cold Atmospheric Pressure Plasma Jet. They can damage DNA. It can be called oxidative damage.

All of living cells can repair the damage in DNA by themselves. Repairing depends on the level of damages. In repairable cases, there may be mutation. This experiment used penicillin enrichment for checking mutation. Skin-clinic-applied CAPPJ of 100% Helium could induce possible mutation of living cells.



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