

Cold Atmospheric Plasma (CAP) Nanotechnology Technique for Biomedical Applications

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Dissertation Proposal

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Cold atmospheric plasma (CAP) is an ionized gas where the ion temperature is close to room temperature as opposed to typical high-temperature laboratory plasmas. It can be carried out in the presence of Helium (He) with a high voltage. CAP is composed of various electrons, positive/negative ions, reactive oxygen species (ROS), reactive nitrogen species (RNS), radicals, excited molecules, energetic photons (UV) and transient electric fields. Based on those compositions, CAP exposure has been shown to be highly effective in several applications including: germicidal and sterilization, wound healing, blood coagulation, material surface modifications and crosslinking, and treatment of various diseases, including cancer.

In this study, plasma-induced surface modification provides a platform to introduce a variety of functional factors. Contact angle and AFM results demonstrated that 3D printing PLA scaffolds after CAP treated were more hydrophilic and more roughness. The above surface property modification will lead to an enhancement of cell attachment and bone cell formation. Furthermore, CAP was used as a light source in photodynamic therapy for melanoma tumor with PpIX-loaded polymersomes. The results of photodynamic therapy showed that CAP has excellent selectivity of kill tumor while keep

minimal damage to health tissues, meanwhile CAP can be used to induce PpIX-loaded polymersomes release and activated PpIX effects, which can enhance anti-tumor efficacy. In addition, Plasma technology is also a useful tool of inactivation of bacteria via oxidized stress produced by CAP.

Future work on this project is aimed at better understanding the mechanisms of CAP interact with cells and bacteria in combined therapy, as well as how to apply CAP surface modified technology in all kinds of polymer based biomedical products. Finally, we hope that based on this study, CAP would develop to a widespread, easy accessible to use, and low cost for regular healthcare tool in the future.