# Influence of $SO_2$ Plasma on Cell Attachment To PET Surface

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***Abstract*—**Various modifications have been applied to vascular PET surfaces to improve their thrombogenicity and cellular adhesion in response to the surfaces. The aim of this study was to apply $SO_2$ plasma in order to reduce the cellular adhesion induced by vascular PET surfaces. Mice fibroblast were exposed to PET surface treated with $SO_2$ plasma. In control group the cells were exposed to untreated PET surface. Cell adhesion was examined using SEM. Our findings indicated that exposure of mice fibroblasts to $SO_2$ plasma treated surfaces resulted in decreased cell adhesion to the surface compared to control group. Our results show that treatment of PET surfaces with $SO_2$ plasma has improving effect on PET surfaces as vascular grafts.

***Index Terms*—**$SO_2$ Plasma, PET, Cell Adhesion.

## I. Introduction

Plasma is one of the four fundamental states of matter, and was first described by chemist Irving Langmuir in the 1920s. Plasma can only be artificially generated by heating or subjecting a neutral gas to a strong electromagnetic field to the point an ionized gaseous substance becomes increasingly electrically conductive, and long-range electromagnetic fields dominate the behavior of the matter. [1] Sulfur dioxide is a colorless gas with a pungent and suffocating odor, similar to a just-struck match. It has an acidic taste and is a liquid when under pressure. Sulfur dioxide is used as a food preservative for some fruits and vegetables. It is also used in metal mining and refining, water treatment, and food processing. [2]

Polyethylene terephthalate, commonly abbreviated PET, is the most common thermoplastic polymer resin of the polyester family and is used in fibers for clothing, containers for liquids and foods, thermoforming for manufacturing, and in combination with glass fiber for engineering resins. PET consists of polymerized units of the monomer ethylene terephthalate, with repeating (C10H8O4) units. PET is commonly recycled, and has the number "1" as its resin identification code (RIC). [3] Purified PET, known as medical grade, has a vast range of application in implantable medical device from hard tissue replacement to vascular grafts as soft tissue prosthesis, because of its desirable physical properties and good compatibility to human body. [4][5]

As a fact introducing novel material to overcome the feebleness of custom material and fulfilling new needs in designing highly efficient medical devices, needs lots of money and scientific efforts, thus modifying existing material properties is considered as a good solution. [6]

Surface modification include physiochemical, mechanical and biological methods by which surface properties alter in polymers surface without much changes happening in bulk of the material.[7] To study cell attachment to biomaterial surfaces, mouse fibroblast (L929 cell lines) are vastly used and exposed to materials which is followed by SEM morphology analysis.[8],[9] The aim of this study was to apply SO2 plasma in order to reduce the cell attachment that might be induced by vascular PET surfaces.

## II. Material And Methods

PET surface was exposed to $SO_2$ plasma in vacuum plasma device. Mouse fibroblast were exposed to PET surface treated with $SO_2$ plasma. In control group the cells were exposed to untreated PET surface. Cell adhesion was examined morphologically using SEM.

## III. Results

Our findings indicated that exposure of mice fibroblasts to $SO_2$ plasma treated surfaces resulted in decreased cell adhesion compared to control group. Figure I shows fibroblasts cell adhesion in control group.

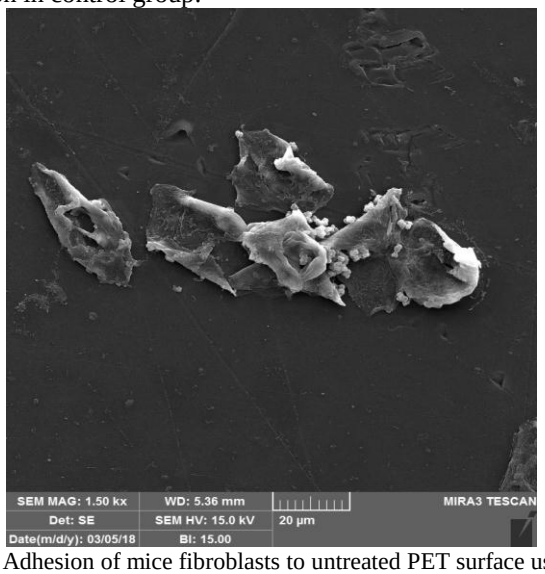


Fig. 1: Adhesion of mice fibroblasts to untreated PET surface using SEM.

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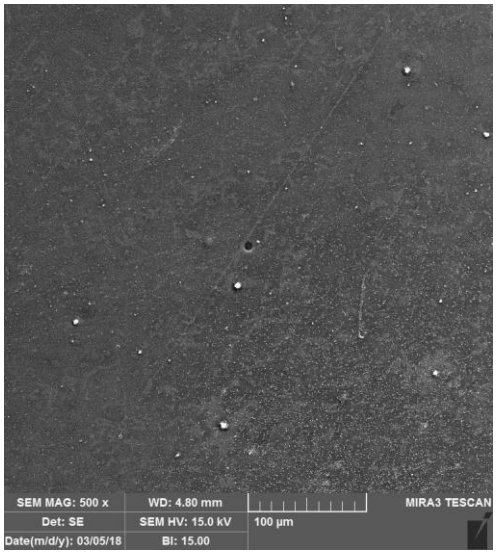


Fig. 2: Adhesion of mice fibroblasts to treated PET surface with $SO_2$ plasma using SEM.

## IV. Discussion

Knitted and woven form of Synthetic Polymers have been successfully applied in vascular graft as a substitution in case of aneurism or blood vessels clog disease. The real challenge rises when needed vascular graft diameters is less than 6 mm which leads to early coagulation and blood clogs. Thus modifying the inner surface of vascular graft that is in direct contact with blood and its components, In order to overcome the coagulation and clogging issue, is necessary. [10], [11], [12]

Plasma surface treatment with different gases like $O_2$, $CO_2$ and $NH_3$ can change physical or chemical properties of material surface by functionalizing, etching and surface polymerization which can be considered as final stage of surface treatment or can mediate the process by later coating with bioactive material or biomolecules adsorbing. [13], [14]

Recent research indicate that oxygen plasma among different process gases results best in improving biocompatibility and better cell adhesion of the treated material but in case of blood compatibility and coagulation problems there are controversial results that shows need for extensive studies in the area. [15]

Treating surfaces with different methods such as coating with heparin, albumin and other coagulators and improving surface hydrophobicity for better endothelial cell adhesion are concepts that can be performed by means of wet chemistry, ion beam emission, corona or plasma glow discharge and Laser beam. [16]

Atmospheric plasma treatment is a precise, rapid and environmentally friendly process leaving no harming pollution. $SO_2$ plasma is a biomimetic method to provide sulfur-oxygen functional groups on the surface of PET which exist in the structure of heparin as one of the main drug and biomolecules used as coagulator and blood compatible coatings. [17] As we have shown plasma surface treatment with sulfur dioxide can reduce protein attachment therefore cell adhesion to the surface of polyethylene terephthalate and inhibit coagulation and blood clogs formation, which is the main failure in most low-diameter synthetic vascular grafts.

## V. Conclusion

Our results show that treatment of PET surfaces with $SO_2$ plasma has improving effect on PET surfaces as vascular grafts.

## Acknowledgment

We appreciate all who helped us to exert this study.

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