

Anatase Film on Orotracheal Tubes to Mitigate *Staphylococcus aureus*

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ABSTRACT

Bacterial contamination in hospital environments is a significant concern for patient admissions. Aiming to reduce contamination, titanium dioxide film (TiO₂) in the anatase phase has been prepared on the surface of polyvinyl chloride (PVC) tubes. The PVC tube material was used to study the film's effectiveness in inhibiting bacterial growth and cell viability. The morphology and composition of deposited films were investigated using a Scanning Electron Microscope (SEM) and Energy Dispersive Spectroscopy (EDS) map. In addition, Fourier-Transform Infrared Spectroscopy (FTIR) and XRD diffractogram were used to analyze film composition and phase, respectively. The adhesion of TiO₂ film on PVC substrate was determined using Scotch™ tape-test according to ASTM: D3359-09, 2010, and the film surface morphology was analyzed by the MEV-FEG technique and EDS map. The bacterial viability was performed with *Staphylococcus aureus*, and cell viability was performed using L929 strain mouse fibroblasts. The results of TiO₂ in the anatase phase deposited by ALD on the PVC surface demonstrate good adherence and the film's effectiveness in inhibiting bacterial growth and cell viability.

KEYWORDS: Anatase, Polyvinyl Chloride (PVC), Atomic Layer Deposition.

1. INTRODUCTION

According to the World Health Organization, 15% of hospitalized patients are targets of healthcare-related infections acquired during care in a hospital or a health care unit [1]. Despite preventive precautions, many variables can lead to patient contamination, significantly when patients are affected by a disease that requires the use of medical devices during treatment. One of them is tracheostomy, a procedure that consists of inserting a stoma region, which can trigger infections due to exposure to the environment and direct contact with the patient's respiratory system [2].

Infections acquired during the care process in a hospital or healthcare facility are defined by the Centers for Disease Control and Prevention (CDC) as healthcare-associated infections or healthcare-related infections (HAIs). This association is when there is no evidence that the patient

already had the infection or was incubating the disease when they entered the healthcare facility [3].

World Health Organization [4] estimated that these infections affect around 15% of hospitalized patients. In developing and underdeveloped countries, this estimate can be up to three times higher. In intensive care units (ICU), this number is about 2 to 5 times higher, considering that, despite the existence of care methods related to prevention, hygiene, and proper disposal of infected materials. It is challenging to control all the variants that can lead to patient contamination, significantly when patients are affected by a disease requiring medical devices during treatment, such as catheters or ventilators [3, 5, 6].

Ventilatory support is a device in which a mechanical ventilator is attached to a tube inserted through the mouth, nose, or tracheal stoma, trachea, and larynx to deliver oxygen to patients with acute or chronic respiratory failure. Ventilatory support can be used together with tracheostomy (TCT), a surgical procedure that consists of inserting a cannula through an incision in the tracheal stoma region. Although efficient, these intubation methods can generate infections due to contamination by exposure

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