Antibacterial Activity of TiO$_2$ Thin Film Produced by Pulsed Magnetron Sputtering on Cotton and Glass Substrates

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Abstract

The search for more efficient and reliable medical equipment (such as medical garments, sheets for hospital beds, among others) has increased. It is well known that every patient that enter a hospital for a wide range of medical procedures and treatments face the potential risk of developing a secondary infection during the time spent in the facilities. The main concerns are related with infections caused by bacterial colonization and its proliferation [1].

Titanium dioxide (TiO$_2$) is a semiconductor material that has high oxidation strength, excellent chemical stability and photochemical properties [2]. TiO$_2$ based materials have been used due to its photocatalytic and self-cleaning abilities, to remove organic contaminants and disinfection of air, water and surfaces. Additionally, some authors have been pointing out that certain microorganism when in the presence of TiO$_2$ and UV light can suffer a photocatalytic decomposition [3].

In this research work, it is aimed the production of TiO$_2$ thin films, by Pulsed DC Magneron Sputtering at room temperature, capable of exhibiting antibacterial activity against E. Coli for hospital applications. The properties of cotton and glass substrates coated with TiO$_2$ thin films were characterized via X-Ray Diffraction (XRD), Scanning Electron Microscopy (SEM), Atomic Force Microscopy (AFM), UV-Visible Spectroscopy and Contact Angle analysis [4]. The photocatalytic activity of the produced thin films was assessed by measuring the photodegradation rate of methylene blue aqueous solution under UV light irradiation for specific interval of times. The antibacterial activity of the TiO$_2$ thin films over Escherichia coli bacteria, induced by the incidence of UV irradiation was evaluated by two methods: the colonies counting on agar plates and in liquid medium containing a Luria–Bertani (LB) bacteria culture medium. The obtained results showed that the thin films have a maximum thickness of about 350nm and the samples that presented the higher photocatalytic activity were deposited with a deposition time of about 120 minutes and a argon and oxygen flow of 30sccm and 2sccm, respectively. The produced samples presented a photodegradation efficiency of about 15%.

References

