BINARY METAL OXIDES THIN FILMS AND THEIR ROLE IN UNDERSTANDING CELL-MATERIAL INTERACTION

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Abstract
Understanding how surface chemistry, material composition, and deposition conditions affect cellular function is crucial for building substrates for bio medicine and orthopedic prostheses. This thesis examines the impact of metal oxide thin films on human and bacterial cell behavior, focusing on VOx, CuTiO, Al2O3, ZnO, and TiO2 as substrates. With Pulsed Laser Deposition (PLD), we achieved 0.1-0.9 nm surface roughness and evaluated all films' hydrophilic characteristics. This ensures ideal cell adhesion research settings. VOx adheres to and promotes the proliferation of human bone marrow-derived mesenchymal stem cells (hBMMSCs) when deposited at 400°C, according to our initial research. Additionally, VOx coatings promoted chondrogenesis while having no effect on adipogenic and osteogenic differentiation. furthermore, Cu0.75Ti0.25O2 films were tested for antibacterial characteristics. A decrease of 20% in bacterial proliferation indicates that these coatings have the potential to inhibit the growth of biofilms. Following our examination of the bio-compatibility of VOx and CuTiO films, we proceeded to conduct a more in-depth investigation including cancer cells and the inhibition of cell development on other metal oxide films. For this purpose, we employed thin films composed of binary oxides such as ZnO, Al2O3, CuO, VOx, and TiO2 to investigate the behavior of cancer cells, yielding diverse outcomes. TiO2 and Al2O3 enhanced adhesion and proliferation to levels that were equivalent to or higher than those observed on regular polyethylene terephthalate (PET) support. However, CuO and ZnO were able to eradicate SKOV3 cells that were seen in ovarian cancer. This extensive investigation demonstrates the intricate and varied biological responses to thin coatings composed of metal oxides. The findings augment our comprehension of the impact of oxide thin films on various cell types, underscoring the significance of material choice in biomedical research.