NewTimes – New Trends in Materials Science and Engineering
1st International Virtual Conference
14-18 June 2021

SESSION 5: New trends in surface science and coatings
Preference: ORAL presentation

Mechanical characterization and cellular studies of Ti-Cu and Ti-Cu-Ag thin films produced by PVD magnetron sputtering, showing biocompatibility and antibacterial properties

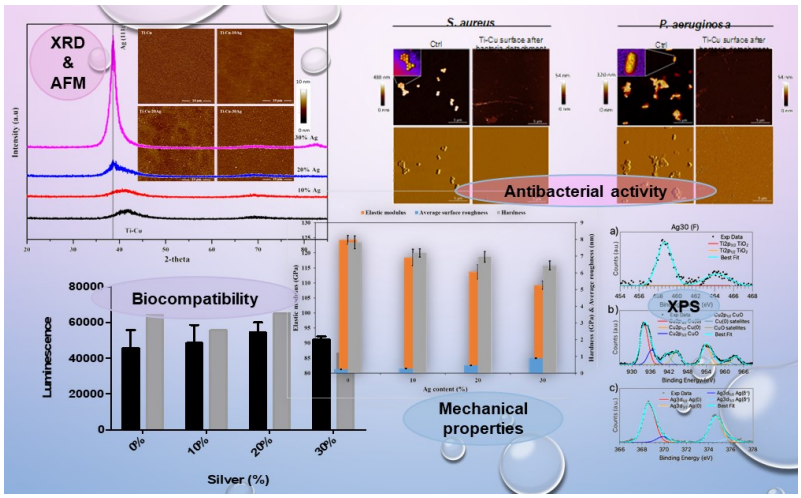
Saqib Rashid*[1], Gian Marco Vita[2], Luca Persichetti[2], Rostislav Daniel[3], Chiara Battocchio[2], Giovanna Iucci[2], Daniela Visaggio[2], Martina Marsotto[2], Edoardo Bemporad[1], Paolo Ascenzi[2], Giovanni Capellini[2], Marco Sebastiani[1], Alessandra di Masi[2]

[1] Università degli Studi Roma Tre, Engineering Department, via della Vasca Navale 79, 00146 Rome, Italy.
[2] Università degli Studi Roma Tre, Department of Science, Viale Guglielmo Marconi, 446, 00146 Rome, Italy.
[3] Department of Materials Science, Montanuniversität Leoben, Franz-Josef-Straße 18, Leoben, 8700, Austria.

One of the main goals of tissue engineering is the preparation of multifunctional biomaterials showing good mechanical properties, biocompatibility, and antibacterial activity simultaneously. Multi-element thin films are a new class of nano-engineered materials showing an excellent combination of high-strength and biocompatibility. Additions of Au, Cu, Zn or Ag to Ti-based films can induce potential antibacterial behavior [1, 2].

In this framework, Ti-Cu and Ti-Cu-Ag thin films were deposited on silicon substrate by physical vapor deposition magnetron sputtering (MS-PVD), with the aim of obtaining concurrent biocompatibility and antibacterial properties with better mechanical properties. The produced films were characterized by X-ray diffraction (XRD), nanoindentation, atomic force microscopy (AFM), scratch adhesion and X-ray photoelectron spectroscopy, to investigate their structural, mechanical, and surface properties. The biocompatibility of thin films is investigated by fibroblasts MRC-5 cell lines. Finally, the antibacterial activity of these thin films against *Pseudomonas aeruginosa* (P. aeruginosa) and *Staphylococcus aureus* (S. aureus) is evaluated and correlated to the Ag contents.

Ti-Cu thin films show~~s~~ complete amorphous structure, but addition of silver changes the film structure to partially crystalline at 20% Ag and completely crystalline at 30% Ag. XPS spectroscopy shows titanium oxidized to Ti (IV), copper partially oxidized to Cu (II) and partially in metallic state while silver remains unoxidized. These thin films show modulus between 105.5-124.5 GPa and hardness of 6-7.85 GPa [3]. The formation of mixed copper and titanium oxide on the surface of Ti-Cu and Ti-Cu-Ag thin films induces high biocompatibility and remarkable antibacterial properties.



[1] *L. Somlyai-Sipos, et. al., Appl. Surf. Sci. Chem. Soc. Rev. (2020), 553, 147494.*
[2] *W. Zhang, et. al., J. Mat. Sci. Technol. (2021), 88, 158.*
[3] *S. Rashid, et. al., Nanomaterials 2021, 11, 435.*
Corresponding Author e-mail: saqib.rashid@uniroma3.it