



**2nd International Conference on
Multidisciplinary Sciences and Technological
Developments (ICMUSTED 2025)**

PROCEEDINGS BOOK

December 12-15, 2025

Bayburt, Türkiye

ISBN: 978-625-7960-84-7



Microstructural and Electrochemical Assessment of Co–Cr Dental Alloys in Ringer Solution

Alberto Daniel Rico-Cano¹, Adriana Saceleanu², Anca Fratila², Julia Claudia Mirza-Rosca^{1,3}

¹Department of Mechanical Engineering, University of Las Palmas de Gran Canaria, Las Palmas de Gran Canaria, Spain

²Medicine Faculty, “Lucian Blaga” University of Sibiu, Sibiu, Romania

³Materials Engineering and Welding Department, Transilvania University of Brasov, Brasov, Romania
Corresponding author: Julia Claudia Mirza-Rosca (e-mail: julia.mirza@ulpgc.es)

Abstract

Metallic biomaterials must exhibit reliable chemical stability and mechanical integrity to be considered safe for clinical use, particularly in dental and orthopedic applications. Among these materials, cobalt–chromium (Co–Cr) alloys remain a preferred choice due to their resistance to wear, their mechanical strength, and the generally favorable biological response they induce. In this study, two commercial Co–Cr dental alloys—Vitallium 2000 Plus and Vera PDI—were examined to compare their microstructural features and corrosion behavior in Ringer solution. Optical and electron microscopy revealed characteristic dendritic structures in both materials. Vitallium 2000 Plus showed a greater presence of carbides and σ -phase particles embedded within the α -matrix, whereas Vera PDI contained only scattered carbide precipitates. Open-circuit potential measurements demonstrated that both alloys passivate rapidly after immersion, stabilizing toward more noble potentials as exposure time increases. Electrochemical impedance spectroscopy confirmed this trend: the spectra displayed capacitive behavior with two distinguishable time constants, associated with passive-film formation and charge-transfer processes. Fitting the data to an equivalent electrical circuit showed a gradual rise in the resistance of both the compact oxide layer and the passive film, indicating increasing protection as immersion progressed. After one week, the polarization resistance approached values on the order of $10^6 \Omega \cdot \text{cm}^2$, which is typical of materials known for excellent corrosion resistance, such as titanium alloys. Vitallium 2000 Plus displayed slightly higher resistance to corrosion, a result consistent with its higher chromium content and the formation of a more stable Cr_2O_3 -rich passive layer. Nonetheless, both alloys produced protective oxides composed mainly of Cr_2O_3 and CoO , which became thicker and more homogeneous over time. The results obtained confirm that the two dental Co–Cr alloys develop robust and long-lasting passive layers in Ringer solution, making them suitable for extended biomedical service.

Keywords: Co–Cr alloys, Dental biomaterials, Corrosion resistance, EIS, Passive films