

Abstract:

Investigation of surface morphology, topography and color changes created in NiTi orthodontic wires during the electrochemical etching process

Introduction: The purpose of this study was to investigate and evaluate the changes in surface properties, morphology and topography of NiTi orthodontic wires changed in color during the anodized electrochemical etching process.

Materials and methods: In this research work, the color change of NiTi orthodontic wires, which were anodized by electrochemical etching method, was investigated in the tested groups including: wire, disc and unmodified rods of this alloy. Also, the physical properties, morphology, surface roughness and contact angle of each sample were investigated using spectrophotometer, scanning electron microscope, atomic force microscope and contact angle analysis system respectively.

Results: By applying a voltage from 10 to 100 volts during the electrochemical etching process for NiTi alloy anodization (such as orthodontic wire), various colors can be produced on its surface. Compared to unmodified NiTi alloy wires, anodized NiTi wires showed lower contact angle and higher roughness. With the increase of the surface roughness and also the images obtained from the FE-SEM field emission scanning electron microscope, it was observed that with the increase of the voltage, the surface roughness and of course the topography of the surface undergoes a change, which was also proved by the AFM atomic electron microscope test. Finally, the results of the CA contact angle test, along with the results of other analyzes, proved the effect of voltage increase on the surface roughness, which leads to an increase in the hydrophilicity of the NiTi alloy surface.

Conclusions: Using the electrochemical etching process for anodizing samples in each of the research groups can change the color of NiTi alloys at different voltages in a fixed time. It was observed that the roughness, topography and also the hydrophilicity of the orthodontic wires produced after the electrochemical process in NiTi alloys increased.

Keywords: Nickel/titanium orthodontic wire, electrochemical etching, physical properties, surface topography, color change