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PIXE, RBS and SEM analysis to quantify the effect of Zr on Ti-alloy wires to be used as orthodontic material

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Recent developments in material science have presented newer archwire materials as well as improvements in the properties of existing ones. Proper selection and understanding of the biomechanical requirement of each case requires proper characterization studies on archwire alloys [1]. Use of orthodontic archwires has some disadvantages such as high surface roughness, which increases friction at the wire-brace interface during the wire sliding process [2]. The surface quality and the surface roughness of dental materials are of utmost importance; these properties determine the area of the contact surface and thus influence on the friction [3]. Two orthodontic archwires preformed rectangular beta titanium III orthodontic archwires (0.43 × 0.64 mm) and Timolium orthodontic archwires (0.040 × 0.64 mm). In addition, pure zirconium was deposited over the archwires. Several thin films of Zr were deposited over titanium orthodontic archwires. Determination of composition and surface roughness of orthodontic wires were performed with Particle-induced Xray emission (PIXE) [4] and Backscattering Spectrometry (BS). SEM analysis was performed to determine the major element composition. In this study the effects of the various thicknesses of the Zr layers deposited onto the Ti-alloy mires to improve the surface roughness of the archwire are investigated. Also reported is the strength of archwires before and after deposition with zirconium and immersion with artificial saliva. [1] Krishnan et. al. (2004) Angle Orthodontist, vol. 74 (6). pp. 825-31. [2] Kappert et. al. (1988). Fortschritte der Kieferorthopadie, vol. 49 (4), pp. 358-367. [3] Tecco et. al. (2009). The Angle Orthodontist, vol. 79 (1), pp. 111-116. [4] Ryan et. al. (1995) NIMB, vol. 104, pp. 157-165.