Effect of Cold Deformation on Superelasticity and Morphology of Four Orthodontic Nitinol Wires

S. K. Sadrnezhaad [1*], A. H. Tavabi [1], S. Ghoreishi [2]

[1] Department of Materials Science and Engineering, Sharif University of Technology

[2] Department of Dentistry, Ferdowsi Medical Science University of Mashhad

Received 16 November 2004; received in revised form 5 February 2005; accepted 7 February 2005

Abstract

Tooth straightening with superelastic wire requires exertion of continued bending as well as tensional forces exerted by the wires to the teeth. The applied force can influence on properties of the wire. Knowing the amount and mechanism of this change results in both improvement of the clinical operation as well as the recovery of the used alloy. Investigating the possibility of exertion of a stable force during the curing period is substantial to orthodontists. Studying the possibility of recovery and re-circulation of the used material is of interest to engineers. The latest results obtained on the effect of bending on transformation temperatures, crystal structure and mechanical properties of four different orthodontic commercial wires are discussed in this paper. It is seen that the width of the hysteresis loop is reduced, percentage of the martensite phase is increased and the possibility of stress induced R-phase formation is increased due to the application of the deflection strains on the samples. The structural phase change occurring during mechanical and/or heating operations indicates that the alloy property can change from superelastic towards shape memory effect via heat treatment after cold working. Microstructural and transformation temperature studies show that R-phase formation is concomitant with the presence of martensite in the wires. These results indicate that the superelastic effects are correlated to the formation and elimination of small forcible hysteresis loop of the R phase.

Keywords: Orthodontic wire; Superelastic; Nitinol; R phase; Stress hysteresis

* **Corresponding Author**
Address: *Center of Excellence for Advanced Processes of Production and Shaping of Materials, Department of Materials Science and Engineering, Sharif University of Technology, Tehran, I.R.Iran*
Tel.: *+98 21 66165215*
Fax: *+98 21 66005717*
E-mail: *sadrnezh@yahoo.com, sadrnezh@sharif.edu*