

ABSTRACT:

This paper presents the mechanical performance of the annealed NiTi Shape Memory Alloy (SMA) coating deposited onto 316L stainless steel substrate. The as-deposited SMA coating, Ni559 Ti441, showed an amorphous behaviour. The crystalline NiTi (SMA) coating was produced by annealing the as-deposited NiTi with a thickness about 20 μm , at above its crystallisation temperature in a vacuum ambient. The annealed NiTi coatings were characterised to determine the effect of the annealing parameters on their mechanical behaviour. The NiTi phases and structures were determined by x-ray diffraction (XRD) and scanning electron microscopy (SEM) whereas the mechanical properties were measured using the Rockwell C adhesion test. Three main phases; NiTi B2 parent phase, Ni₃Ti and TiO₂ were found in the annealed samples and the intensities of each phase were dependent on the annealing temperature and annealing time. Each phase significantly affected the mechanical behaviour of the coatings. Higher intensities of Ni₃Ti and TiO₂ phases were believed to contribute to the low adhesion of the annealed NiTi coatings due to their brittle properties. The annealing parameters; 600 °C for durations of 30 min was considered as the optimum parameter, yielding no fine cracks at the Rockwell C indentation interface compared to other samples at high magnification under the SEM. Adding a hard top layer of TiN would potentially provide a hard coating with an interlayer capable of absorbing impact which would be very suitable for ball joints used in hip replacement therapy.