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Atomised NiTiTa from elemental powders for additive manufacturing of biomedical components

Motibane, Londiwe P
Council for Scientific and Industrial Research (CSIR)
Meiring Naude Drive, Pretoria, 0184
Email: LMotibane@csir.co.za

Readily available feedstock for Additive Manufacturing (AM) is in high demand as the technology advances and finds more applications worldwide. As such, the field of designing advanced alloys tailored for AM requires powder feedstocks engineered for both printability and application-specific performance. Nitinol (NiTi) is a shape-memory alloy that is biocompatible, super-elasticity, and exhibits the shape-memory effect; however, its functional window remains narrow for next-generation implants. Here we refine NiTi through ternary alloying with tantalum to create NiTiTa powder using ultrasonic atomisation under a highly controlled inert atmosphere on an Amazemet rePowder platform. To accommodate the disparate melting points and suppress elemental evaporation, two alloying strategies are considered and discussed: Ni, Ti and Ta mix, and Ti and Ta mix with the addition of Ni in the second phase of casting. Cast-rod microstructures, powder morphology, NiTi (D_{50} ≈ 51 μm), and chemical composition (Ni 51.78, Ti 46.24 and Ta 1.98 wt.%) were characterised by SEM-EDS and XRD. Differential scanning calorimetry revealed a tailored martensitic transformation range (As ≈ 28 °C) suitable for physiological conditions. XRD confirmed predominant B2 and B19′ phases with minor Ta peaks. The findings confirm the feasibility of producing homogeneous, AM-ready NiTiTa powders, providing the foundation for forthcoming laser powder bed fusion trials aimed at patient-specific biomedical devices.