Contribution ID: **57** Type: **3. Oral presentation**

Contamination, Phase Composition and Microstructure of SPS Zr–50%Ti Produced from Powders Obtained by Mechanical Synthesis and Plasma-Based Ultrasonic Atomization

Thursday, 3 September 2026 09:30 (20 minutes)

Commercial Zr–xTi powders are unavailable because zirconium alloys are difficult to synthesize due to high reactivity and ignition risk. High-zirconium Zr–xTi biomaterials have received limited attention, and the optimal Zr/Ti ratio for medical use is still unclear. Zirconium and titanium show infinite solid-state solubility; however, most research powders are produced by mechanical alloying (MA), which can markedly affect the phase constitution and microstructure of SPS-sintered parts. Here, Zr–50%Ti powder was prepared by two routes—MA and ultrasonic plasma atomization—using the same elemental Ti (APS, 98.5%; 45 μm) and Zr (APS, 99.9%; 45 μm) feedstock. Blends were mixed in a planetary mill (100 rpm, 36 h) with zirconia bowls and balls. Powder purity, morphology and particle size were evaluated, including laser particle-size analysis. MA produced finer particles (average 19.63 μm), whereas the atomized powder showed a bimodal distribution with a larger mean size (34.9 μm). Both powders were SPS-sintered at 1000–1100 ℃. Phase composition was assessed by X-ray diffraction and microstructure by SEM; oxygen, nitrogen and hydrogen contamination was quantified in the sintered materials. Overall, MA-derived specimens exhibited more complex phase composition and microstructural features than those obtained from atomized powders. These results indicate that powder-production route is a key driver of structural heterogeneity and impurity uptake in Zr–Ti alloys processed by SPS.

Professional Status of the Speaker

Senior Scientist

Interest in submitting a paper in a special issue of

No interest

Invitation letter for visa

No

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Session Classification: Field assisted sintering technology/Spark Plasma Sintering FAST/SPS

Track Classification: Group 3: Field assisted sintering technology/Spark Plasma Sintering FAST/SPS