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Use of selective laser fusion in Zircaloy and tungsten alloy for employ in end-caps for nuclear fuel element rods and shielding

Pereira, L.T.(1); Mucsi, C.S.(1); Florentino, E.(1); Luiz, L.(2); Behmer, W.(2); Fasano, A.C.A.(2); Rossi, J.L.(3);

(1) IPEN; (2) IPEN - CNEN/SP; (3) Omnitek;

This study shows that it is possible to obtain parts of zirconium alloy called Zircaloy-4 (Zry-4) through selective laser melting (SLM), using metal chips as raw material. Additive manufacturing technology is emerging in Brazil, whose principle is the manufacture of a piece layer by layer from a metallic powder. Zirconium alloys are widely used in nuclear reactors, mainly in fuel element cladding and grids. The closing of the ends of the rods is done by end-caps, which is machined and generates large amounts of chips, which are a valuable source for the reuse of zirconium, having the advantage of being hafnium-free. After hydriding the Zircaloy it becomes zirconium hydride (ZrH_2) and can be ground, obtaining the alloy in powder form to be used in SLM. A tungsten alloy with SLM technology was also studied due to its high melting temperature, high density and high mechanical strength, which can be used in shielding against radiation. In this study, a thin layer of alloys was cast on a substrate, which were evaluated for chemical composition, microstructure, hardness and roughness, whose results indicated values compatible with the stipulated requirements.