Feasibility evaluation of a new quaternary Zn alloy wire with 420 nm Zn grain size in uterine microenvironment

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Abstract Biodegradable Zn-Cu-Li-Mg (ZCLM09) alloy wires are developed for application in uterine microenvironment. After extrusion and multi-pass cold drawing, ZCLM09 wires of 0.3 mm in diameter exhibit yield strength of 257 MPa, tensile strength of 341 MPa, and elongation to failure of 43%, which are better than most of the reported biodegradable Zn alloy wires. Distribution of Li is characterized by three-dimensional atomic probe and time-of-flight secondary ion mass spectrometry. A novel $(Li, Mg)_2Zn_{11}$ ternary phase is identified. Immersed in simulated uterine fluid for 28 days, corrosion rate of ZCLM09 wire decreases from 1.35 mm/year at day 1 to 0.15 mm/year at day 14 and then stabilized. Mouse fibroblast cells viabilities for 1 day and 3 days are all over 100%, indicating complete cytocompatibility. According to an inhibition zone diameter of 11.5 against Staphylococcus aureus , ZCLM09 wire has an excellent antibacterial property. The mechanical properties of ZCLM09 wire even far exceed the basic requirements of biodegradable metals for application in bone, which is also very satisfying for uterine cavity applications. It has excellent degradation performance and biocompatibility in the simulated uterine cavity microenvironment. So, it is a good candidate material for gynecological implants.

Keywords Biodegradable Zn alloy wires; Microstructure; Mechanical properties; Biocompatibility