Modeling with FCA-based model of microstructure evolution in ultra-thin wires of MgCa08 alloy during hot drawing

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ABSTRACT

Magnesium alloys are widely applied in medicine due to their high biocompatibility and solubility in human body. For example, they could be applied for surgical threads used for integration of tissue [1,2]. This application requires wires diameter of 0.1 mm and smaller. A new manufacturing process of thin wires, including drawing in heated dies, was developed by Authors [3,4] for biocompatible Mg alloys. An occurrence of recrystallization is the main condition of such a process, which does not use intermediate annealing between the deformations. Because the trial and error method is very expensive and ineffective, a numerical modeling was applied for process design and its optimization. A model of recrystallization of MgCa0.8 alloy in macro scale was developed previously [5]. This model allows for prediction and optimization of drawing process parameters. However, basing on the results of the study [5], we conclude that some microstructural phenomena should be additionally considered in the case of ultra-thin wire drawing in the heated tools. An analysis of the effect of the wire diameter on recrystallization kinetics was an object of interest, especially when wire diameter is comparable with grain size. Study of influence of such a geometrical parameter was fulfilled with use of FCA-based model. The modelling shows that an approaching of the wire diameter to the grain size elongates the recrystallization process with other conditions the same. For example, a decrease of the diameter from 200 to 20 μm extends the recrystallization time by 30%. The recrystallization kinetics is presented in figure. From the practical point of view, the results detached such a geometrical parameter can be implemented into simpler models of recrystallization, e.g. JMAK-based models.

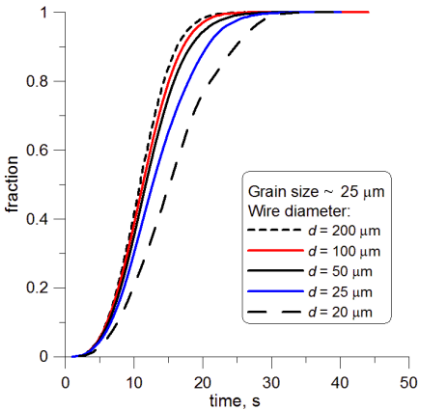

Figure. The recrystallization kinetics for temperature of drawing 300 ^{0}C.

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