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Effects of stress on corrosion of magnesium

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Abstract

1. Introduction Magnesium is currently attracting attention as a new biomaterial because it has sufficient strength and is safe when decomposed in the body. However, its high activity and low corrosion resistance cause it to decompose before it can fulfill its role. For practical use, it is necessary to control the degradation system. Compressive plastic deformation has been reported as one of the methods to control corrosion1), but there are also reports of accelerated corrosion2). Therefore, we focused on the amount of dissolved oxygen in the test solution, which had not been considered. Polarization tests and immersion tests were conducted under uniform amounts of dissolved oxygen. 2.Experimental procedure A magnesium square (99.0% purity) was used as the specimen. The specimens were ground to #2000 abrasive paper after cutting into approximately 6×6×36 mm, buffed with a mixture of 0.05 µm grain size alumina abrasive and ethanol, ultrasonically cleaned in acetone for 10 minutes, and annealed in a vacuum heat treatment furnace at 623 K for 1 hour to remove stress. Some specimens were plastically bended to stresses at 100 MPa and 150 MPa in 4-point bending. The polarization and immersion tests for the compressed side of the specimens were in 0.9% NaCl solution at 310 K. The amount of dissolved oxygen in the solution prepared ranges from 9.50 to 10.0 mg/L. The corrosion potential was measured by sweeping the potential from -2.0 V to -1.2 V at a rate of 1 mV/s using the potentiostat. A saturated calomel electrode was used as the reference electrode, and platinum as the counter electrode. The corrosion rate was estimated from the amount of the evolved hydrogen gas in the immersion test for 72 hours. 3. Results and discussion In the polarization test, the higher the stress-loaded specimen, the lower the corrosion potential, as shown in Fig.1. In the immersion test, however, there was little dependence of the corrosion rate on loaded stress. However, the initial gas generation was greater for the stressed specimens.

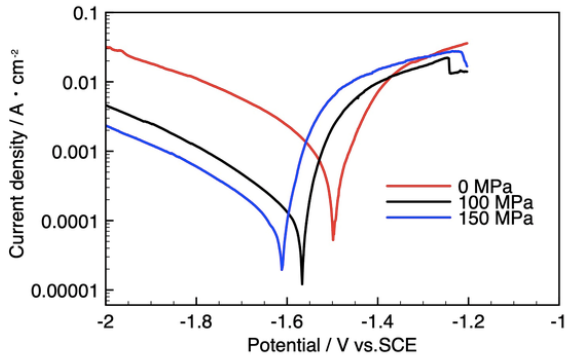

Fig.1 Polarization test results

References
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2)Y. Zheng and Y. Li, Corrosion Sci. **90** (2015) 445-450.