

Title of the TRANSCOM 2025 paper

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INTRODUCTION

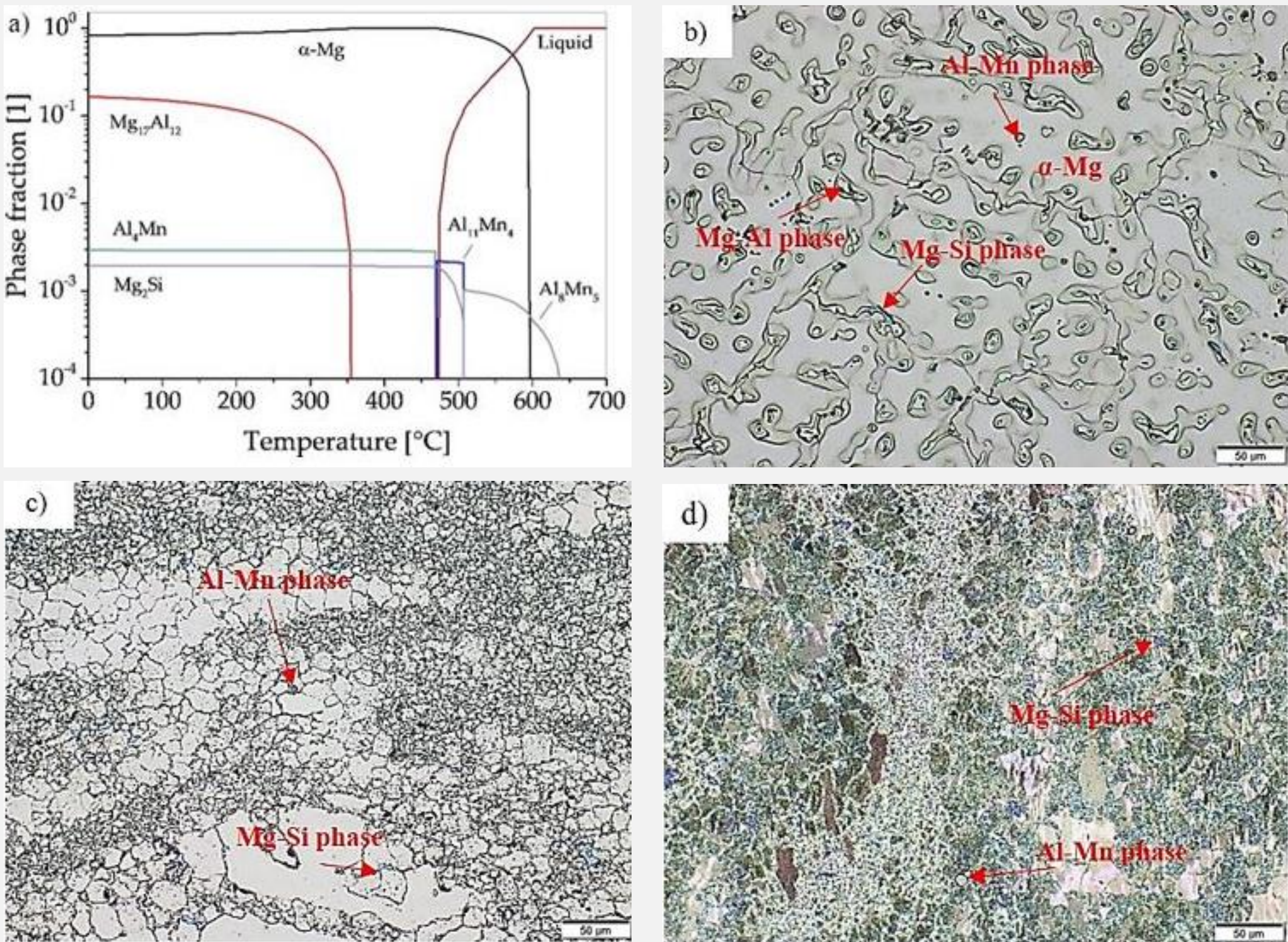
- Magnesium and its alloys are the lightest structural materials.
➤ The increased demand is due to their excellent properties such as low density, high strength to weight ratio recyclability and biocompatibility.
➤ The low corrosion resistance of magnesium and its alloys reduces their applicability.
- The poor corrosion resistance is attributed to the high reactivity as well as the negative standard potential of magnesium resulting in galvanic coupling corrosion and the gradual formation of a porous passivation film.
➤ This problem can be overcome by appropriate heat treatment.
- To provide the findings about the influence of open circuit potential (OCP) time of heat treated AZ80 magnesium alloy in an aggressive chloride environment.
➤ Longer OCP time leads to the formation of a passive layer that improves corrosion resistance of the substrate.

MATERIALS, METHODS & IMPLEMENTATION

- AZ80 magnesium alloy was prepared in a resistance heated furnace.
➤ The chemical composition of the cast samples was analyzed by optical emission spectroscopy.
➤ To obtain the analysis of the individual phases in the material, thermodynamic calculations were performed in the equilibrium state.
➤ Study of the microstructure was carried out using optical optical microscopy.
➤ Corrosion characteristics of the as-cast, as-extruded and extruded + heat treated state were obtained by potentiodynamic polarization tests (PDP) at the laboratory temperature in 0.1 M NaCl.

RESULTS

Thermodynamic calculations and microstructure

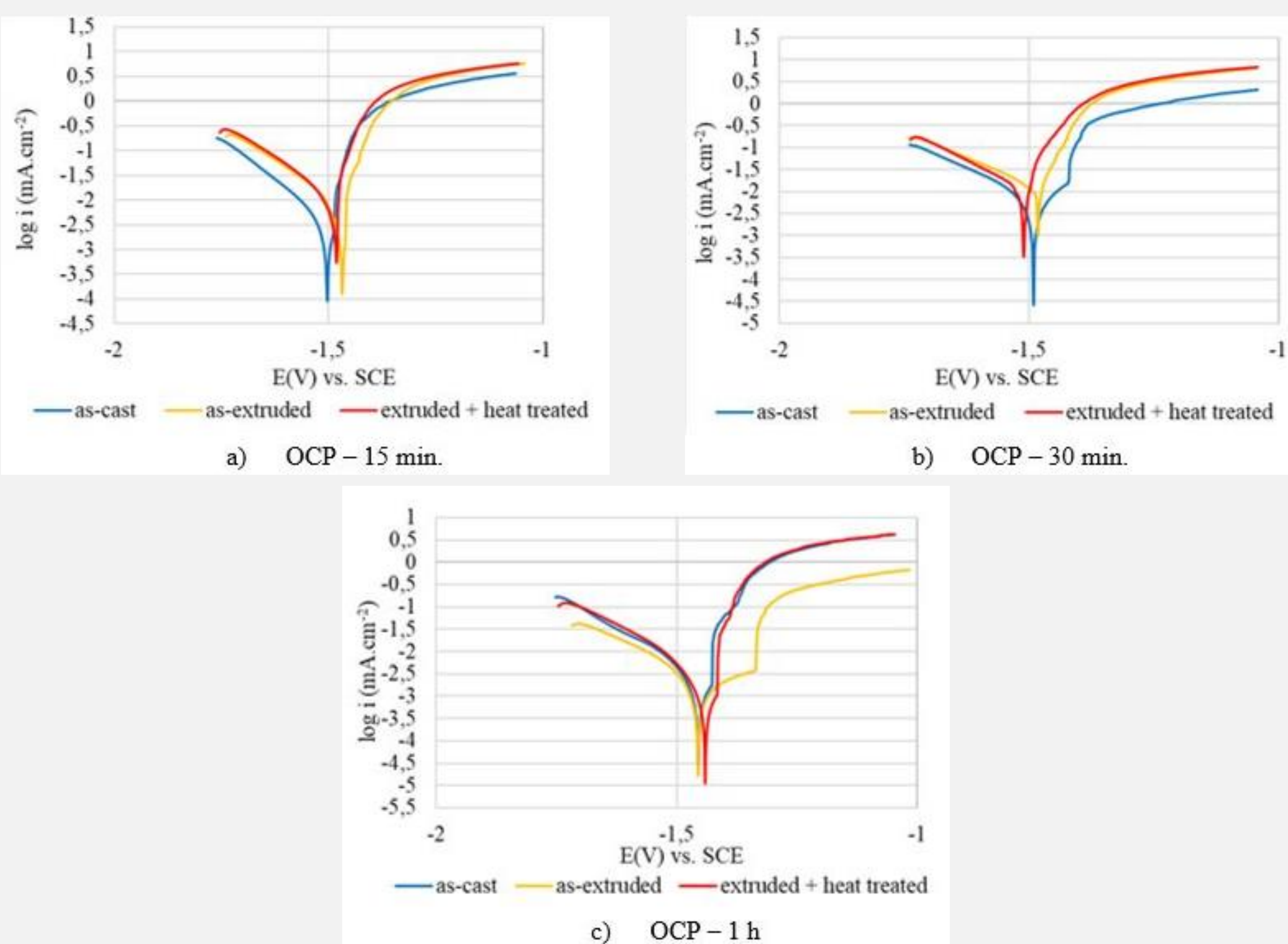


Thermodynamic equilibrium calculations of AZ80 alloy (a); microstructures of AZ80 in as – cast state (b), as-extruded (c) and extruded + heat treated (d) in transverse direction.

Electrochemical characteristics of AZ80 alloy with 15 min. OCP.

State of the surface	E_{corr} [mV vs. SCE]	i_{corr} [$\mu A.cm^{-2}$]	β_c [mV/dec.]	β_a [mV/dec.]	r_{corr} [μmpy]
as-cast	-1509 ± 4	4.78 ± 1.42	152 ± 20	44 ± 18	109.50 ± 32.62
as-extruded	-1487 ± 18	6.17 ± 0.68	158 ± 2	38 ± 6	141.10 ± 15.61
extruded + heat treated	-1492 ± 7	12.05 ± 2.40	169 ± 18	37 ± 2	275.58 ± 54.76

Potentiodynamic polarization tests



Potentiodynamic polarization curves of AZ80 magnesium alloy in measured 0.1 M NaCl.

Electrochemical characteristics of AZ80 alloy with 30 min. OCP.

State of the surface	E_{corr} [mV vs. SCE]	i_{corr} [$\mu A.cm^{-2}$]	β_c [mV/dec.]	β_a [mV/dec.]	r_{corr} [μmpy]
as-cast	-1454 ± 7	3.69 ± 0.61	164 ± 9	34 ± 8	84.56 ± 14.01
as-extruded	-1449 ± 7	4.22 ± 2.15	174 ± 19	64 ± 55	96.65 ± 49.01
extruded + heat treated	-1453 ± 13	2.36 ± 0.35	133 ± 4	29 ± 4	54.05 ± 7.96

Electrochemical characteristics of AZ80 alloy with 1 h OCP.

State of the surface	E_{corr} [mV vs. SCE]	i_{corr} [$\mu A.cm^{-2}$]	β_c [mV/dec.]	β_a [mV/dec.]	r_{corr} [μmpy]
as-cast	-1487 ± 7	5.91 ± 0.31	178 ± 4	57 ± 18	135.28 ± 7.22
as-extruded	-1473 ± 19	10.23 ± 2.61	193 ± 18	45 ± 11	234.05 ± 59.66
extruded + heat treated	-1483 ± 23	10.71 ± 0.35	200 ± 24	46 ± 17	245.05 ± 7.92

CONCLUSION & IMPLEMENTATION PATH

- Influence of open circuit potential time on the corrosion resistance of heat-treated AZ80 Mg alloy was studied. The main conclusions are as follows:
- The microstructure of the as-cast AZ80 Mg alloy consists of polyhedral grains with certain amount of Mg-Al, Mg-Si and Al-Mn intermetallic phases.
- Microstructural investigations showed low thermal stability of the Mg-Al intermetallic phase compared to the Mg-Si and Al-Mn intermetallic phases.
- Longer OCP time (1 h) showed for all heat treated states better corrosion resistance for all heat-treated states, due to the formation of a passivation layer. This behavior was mostly pronounced in the extruded + heat treated state with values of the E_{corr} (-1453mV), i_{corr} (2.36 $\mu A.cm^{-2}$) and the r_{corr} (54.05 μmpy) compared to the shorter OCP times (15 min. and 30 min.).

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