Dataset for the manuscript

**Deposition and Corrosion Performance of Phosphate-Polylactic Acid Composite Coatings on WE43 Magnesium Alloy**

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\*\*\*General Introduction\*\*\*

This dataset contains raw data related to phosphate chemical conversion coatings (CaP), polylactic acid (PLA) biopolymer coatings, and combined CaP-PLA bilayer coatings obtained on the surface of the commercial WE43 Mg alloy.

The data was collected at Jerzy Haber Institute of Catalysis and Surface Chemistry, Polish Academy of Sciences (Poland) and Belarusian State Technological University (Belarus).

All data are provided under CC0 license.

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\*\*\*Aim of this research\*\*\*

The aim of this study was to investigate the physicochemical properties and corrosion performance of CaP, PLA, and CaP-PLA coatings on the surface of the WE43 alloy in Hank’s solution and evaluate their corrosion mechanisms.

\*\*\*Characterization techniques\*\*\*

Scanning electron microscopy (SEM)

The surface morphology and elemental composition of the WE43 samples before and after corrosion experiments were investigated using a JSM-5610 LV (SEM) equipped with a JED-2201 energy-dispersive X-ray spectroscopy (EDX) system.

X-ray diffraction (XRD)

XRD patterns were recorded using a D8 Advance Bruker AXS X-ray diffractometer with Cu Kα radiation. Tube parameters: 40 kV/30 mA. Scanning was done in a continuous mode in 2θ range 5–90 degrees with a scan step of 0.1 degree.

Fourier-transform infrared (FTIR) spectroscopy

FTIR spectra were acquired using a ThermoFisher Scientific Nicolet iN 10 microscope with 128 repetitions and gold as a background standard.

X-ray photoelectron spectroscopy (XPS)

XPS measurements were performed using a Gammadata Scienta hemispherical analyzer SES R4000. The non-monochromatic AlKα radiation (1486.6 eV) used to excite the photoelectrons was generated by the anode operating at 12 kV and 15 mA. The survey scans were collected at pass energy of 200 eV (with 0.25 eV step) and high resolution spectra were collected at pass energy of 100 eV (with 25 meV step).

Electrochemical Impedance Spectroscopy (EIS)

EIS measurements were carried out at the OCP over the frequency range from 105 to 10–2 Hz using a sinusoidal perturbation amplitude of 10 mV. Prior to EIS experiments, the OCP was stabilized for 30 min. Measurements were carried out on an AutolabPGSTAT302N potentiostat/galvanostat. A traditional three-electrode setup was used. The working electrode was mounted at the bottom of the cell to avoid the accumulation of hydrogen gas. Potential values were recorded relative to a saturated Ag/AgCl reference electrode, and a Pt-mesh served as a counter electrode. The surface area of all samples was 1 cm2.

Medusa Calculations:

The equilibrium diagrams were calculated using the Medusa Software (KTH Royal Institute of Technology, Sweden) [1] based on the SOLGASWATER algorithm with 200 calculation steps along each axis. Values of the thermodynamic equilibrium constants were obtained from the embedded Hydra database.

[1] – https://www.kth.se/che/medusa

\*\*\*General description of the data in this data set\*\*\*

Data is divided into 6 folders based on the measurement technique:

SEM – Scanning electron microscopy and energy-dispersive X-ray spectroscopy (EDX);

XRD – X-ray diffraction;

XPS – X-ray photoelectron spectroscopy;

FTIR – Fourier-transform infrared spectroscopy;

EIS – Electrochemical impedance spectroscopy;

Medusa – Calculations in Medusa software.

Each file has a following name structure:

A\_B\_C.D

where

A – Measurement technique (described above);

B – Coating type (described below);

C – Measurement condition (described below in detail);

D – File extension (format).

Parameter B has values:

CaP – phosphate chemical conversion coating on the WE43 alloy;

PLA – polylactic acid biopolymer coating on the WE43 alloy;

CaP-PLA – layered phosphate/polylactic acid coating on the WE43 alloy;

WE43 – Mg alloy WE43 without coating.

\*\*\*Detailed description of the data files\*\*\*

–Folder XRD

This folder contains 8 files, with the name C parameters as follows:

Ob – as obtained;

Cor – after corrosion in Hank’s solution.

Files are presented in format CSV and have 2 columns: Angle (2θ angle) and Intensity (Intensity).

–Folder FTIR

This folder contains 8 files, with the name C parameters as follows:

Ob – as obtained;

Cor – after corrosion in Hank’s solution.

Files are presented in format CSV and have 2 columns: Wavelength and Intensity.

–Folder XPS

This folder contains 7 files, with the name C parameters as follows:

Ob – as obtained;

Cor – after corrosion in Hank’s solution.

Files are presented in format vms and can be opened by XPS proceeding software (CasaXPS).

–Folder SEM

This folder contains 40 files, with the name C parameters as follows:

Ob; Ob-1; Ob-2; Ob-3 – as polished (different magnifications);

Ob-Mg – EDX in the range of Mg element as polished;

Ob-Y – EDX in the range of Y element as polished;

Ob-Nd – EDX in the range of Nd element as polished;

Ob-Gd – EDX in the range of Gd element as polished;

Ob-Dy – EDX in the range of Dy element as polished;

Cor; Cor-1; Cor-2; Cor-3 – after corrosion in Hank’s solution (different magnifications);

Ob-Cr – SEM images of crosscut as obtained;

Cor-Cr – SEM images of crosscut after corrosion in Hank’s solution.

Ob-Cr-Mg – EDX in the range of Mg element of crosscut as polished;

Ob-Cr-Ca – EDX in the range of Ca element of crosscut as polished;

Ob-Cr-P – EDX in the range of P element of crosscut as polished;

Image files are presented in JPG or BMP formats and EDX data is in txt format and have results in at% and wt%.

–Folder EIS

This folder contains 4 files, with the name C parameters as follows:

Cor – during corrosion in Hank’s solution.

Files are in .z format and can be opened in EIS analysis software (ZView).

–Folder Medusa

This folder contains data file (.dat) used for calculations and obtained diagrams with name C parameter:

Data – data file;

Con – concentration diagram;

Fr – fraction diagram.

Image files are presented in WMF formats and data file is in dat format and can be opened in Medusa software.