

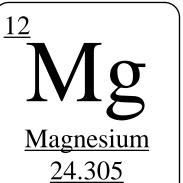
Corrosion Behavior of Pure Magnesium Substrate Coated with Polydopamine Layer in Cell Culture Medium

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Introduction



Inhibition of rapid corrosion of pure Mg



Objective

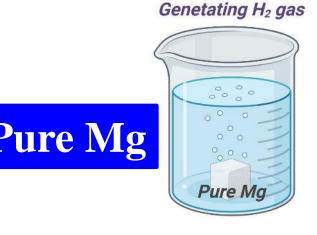
Dopamine (DA)

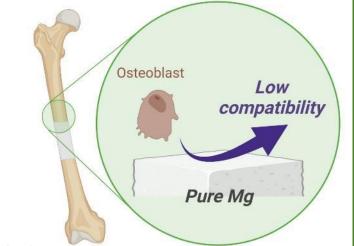
✓ Biodegradable ✓ Biocompatibility

 $Mg(s) + 2H_2O \rightarrow Mg(OH)_2(s) + H_2(g)$ $Mg(OH)_2(s) + HPO_4^{2-}(aq) + Ca^{2+}(aq) + H_2O(1)$ \rightarrow Ca_x(PO₄)_v·n H₂O (s) + H₃O⁺ (aq) + Mg^{2+} (aq)

Mg alloys are using for orthopedic surgery.

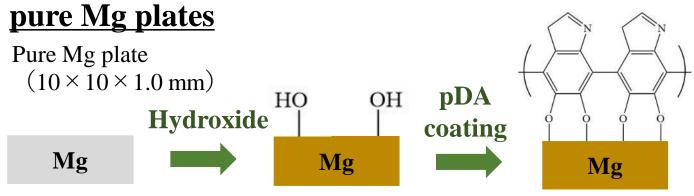






Rapid corrosion

(Essential element) Pure Mg



Film formation by self-polymerization *Ji Hyun Ryu et al., ACS Appl. Mater. Interf., 20(2018)7523.*

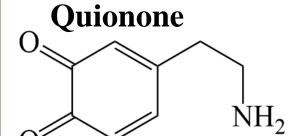
Pure Mg

• Biological substance

metallic materials

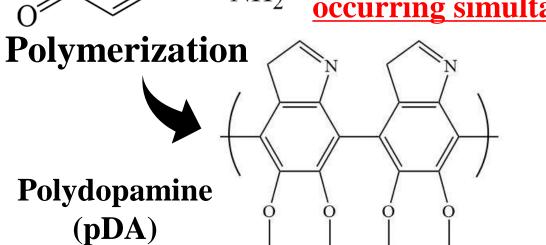
Coordination bond with

- Oxidation



Problems

Polydopamine coating and Mg corrosion will be occurring simultaneously.



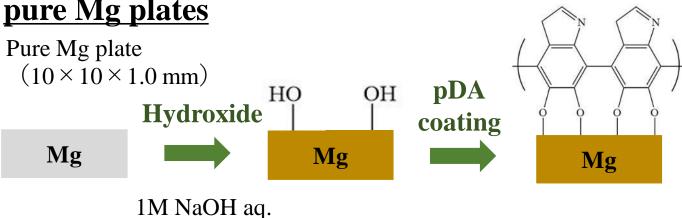
 $Mg^{2^{+}}$

Corrosion

αΜΕΜ (10% FBS, Contains antibiotics) 5.0 mL/sample

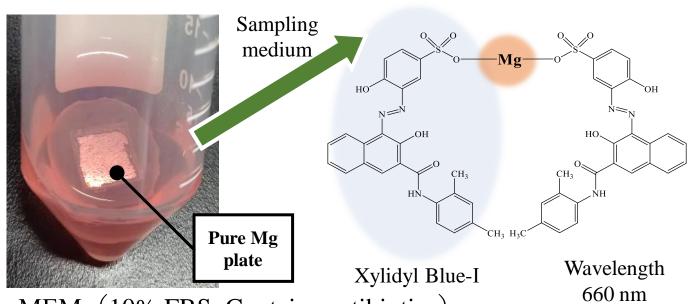
Materials and methods

Examination of pDA coating conditions on



Decomposition behavior of pure Mg in cell culture medium

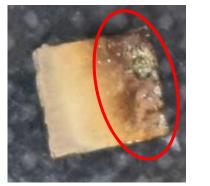
Quantification of Mg²⁺ ions



Results and discussion

Optimization of solvents for pDA coating

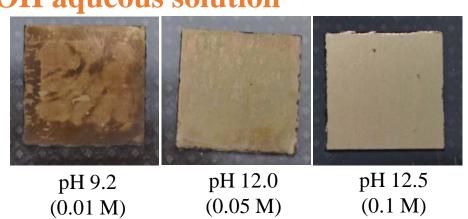
Boric acid/potassium chloride buffer



Corrosion → effect of **chloride ion** $Mg(OH)_{2(s)}+2Cl_{(aq)}$ \rightarrow MgCl_{2(s)}+2OH⁻

Alexander Kopp et al., Acta Biomat., 98(2019)23

NaOH aqueous solution



No corrosion of the pure Mg substrate was observed during the reaction in NaOH solution..

Eluting behavior of Mg²⁺ ion in culture medium

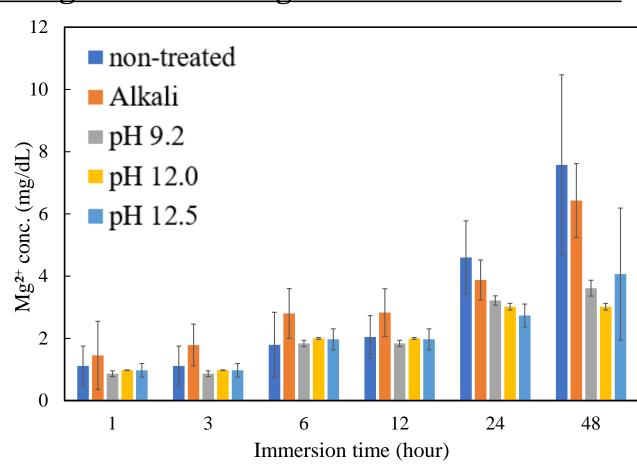


Fig. 2 Eluting behavior of Mg²⁺ ion from pure Mg substrate in cell culture medium (10% FBS).

X-ray photoelectron spectroscopy (XPS)

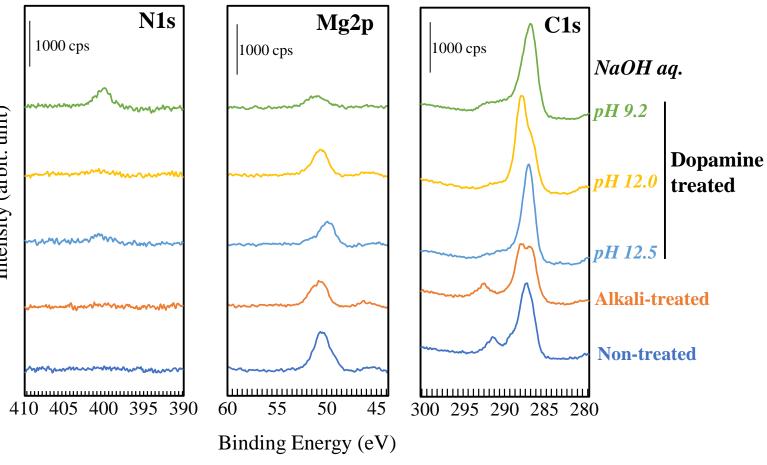


Fig. 1 XPS spectrum of pure Mg surface treated with DA solution. After reaction: DA-derived N1s were detected, and substrate-derived Mg2p was attenuated.

Polydopamine was coated on the pure Mg surface.

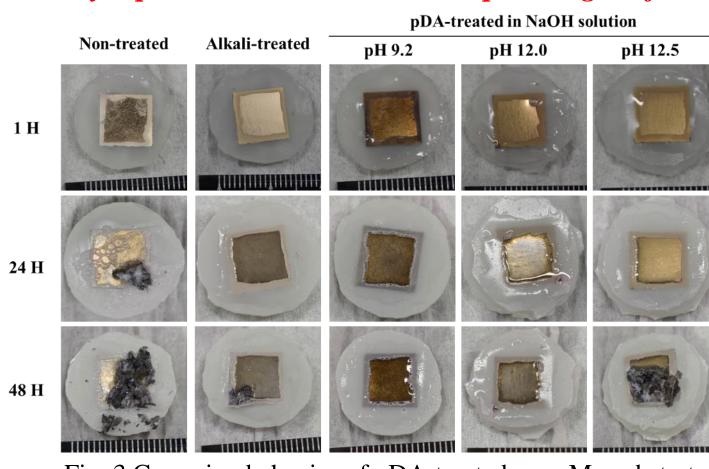


Fig. 3 Corrosion behavior of pDA-treated pure Mg substrate in cell culture medium (10% FBS).

Low Mg²⁺ eluting was found in the case of pDA coated-pure Mg (pH 9.2 or 12.0).

Conclusion

- Polydopamine was coated on pure Mg surface via the polymerization reaction in NaOH solution.
- Corrosion decomposition of pure Mg was suppressed by polydopamine coating.