

## CORROSION RESISTANCE OF MEDICAL MATERIALS IN HYDROGEN PEROXIDE SOLUTION

Guzenkova Alexandra Sergeevna<sup>1,2</sup>, Guzenkov Sergey Aleksandrovich<sup>1,2</sup>,  
Ha Huu Son<sup>2</sup>, Doan Quy Hieu<sup>2</sup>, Do Dinh Trung<sup>2\*</sup>

<sup>1</sup>A.N. Severtsov Institute of Ecology and Evolution Problems of the Russian Academy of Sciences

<sup>2</sup>Institute of Tropical Durability - Joint Vietnam-Russia Tropical Science and Technology Research Center

| ARTICLE INFO                                                                                                                                              | ABSTRACT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
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| <b>Received:</b> 15/11/2025<br><b>Revised:</b> 13/4/2026<br><b>Published:</b> 14/4/2026                                                                   | Hydrogen peroxide is the primary active ingredient in many medical antiseptic solutions used for mouth rinsing and oral hygiene. However, the potential corrosion risks to dental materials under frequent exposure have not been fully evaluated. This study examines the corrosion resistance of four dental materials — a Co–Cr alloy, a titanium alloy, 30ChGSNA steel, and the glass ionomer cement GC Fuji I— in a 3% mass H <sub>2</sub> O <sub>2</sub> solution. Gravimetric analysis was used to determine corrosion rates over time, while solution pH and the volume of released oxygen were monitored to characterize the kinetics of peroxide decomposition and the associated corrosion mechanisms. The results show that 30ChGSNA steel undergoes rapid corrosion within the first few minutes, accompanied by the release of Fe <sup>2+</sup> ions and the formation of an Fe(OH) <sub>3</sub> surface layer. The Co–Cr alloy displayed significantly lower corrosion rates, whereas the titanium alloy and GC Fuji I were essentially unaffected under the test conditions. Kinetic data indicate that the corrosion rate is strongly correlated with the amount of oxygen released during H <sub>2</sub> O <sub>2</sub> decomposition. Overall, the study concludes that modern dental materials such as Co–Cr alloys, titanium, and glass ionomer cements exhibit high stability in peroxide-rich environments, whereas iron-containing materials require careful consideration when peroxide-based antiseptic solutions are used over extended periods. |
| <b>KEYWORDS</b><br>Dental alloys<br>Aqueous hydrogen peroxide solution<br>Corrosion resistance<br>Gravimetric analysis<br>Oxygen depolarization corrosion |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

## KHẢ NĂNG CHỐNG ẮN MÒN CỦA VẬT LIỆU Y TẾ TRONG DUNG DỊCH HYDRO PEROXIDE

Guzenkova Alexandra Sergeevna<sup>1,2</sup>, Guzenkov Sergey Aleksandrovich<sup>1,2</sup>,  
Hà Hữu Sơn<sup>2</sup>, Đoàn Quý Hiếu<sup>2</sup>, Đỗ Đình Trung<sup>2\*</sup>

<sup>1</sup>Viện Sinh thái và tiến hóa - Viện Hàn lâm Khoa học Liên bang Nga,

<sup>2</sup>Viện Độ bền Nhiệt đới - Trung tâm Nhiệt đới Việt - Nga

| THÔNG TIN BÀI BÁO                                                                                                                      | TÓM TẮT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
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| <b>Ngày nhận bài:</b> 15/11/2025<br><b>Ngày hoàn thiện:</b> 13/4/2026<br><b>Ngày đăng:</b> 14/4/2026                                   | Hydrogen peroxide là thành phần hoạt tính chính trong nhiều dung dịch sát trùng y tế dùng để súc miệng và vệ sinh khoang miệng, song nguy cơ ăn mòn các vật liệu nha khoa khi tiếp xúc thường xuyên chưa được đánh giá đầy đủ. Nghiên cứu này xem xét khả năng chống ăn mòn của bốn vật liệu nha khoa gồm hợp kim Co–Cr, hợp kim titan, thép 30XTCHA và xi măng thủy tinh-ionomer GC Fuji I trong dung dịch 3% H <sub>2</sub> O <sub>2</sub> . Phương pháp phân tích trọng lượng được sử dụng để xác định tốc độ ăn mòn theo thời gian; đồng thời pH dung dịch và thể tích giải phóng oxy được đo nhằm mô tả động học phân hủy peroxide và cơ chế gây ăn mòn. Kết quả cho thấy thép 30XTCHA bị ăn mòn mạnh ngay từ vài phút đầu, với sự xuất hiện của ion Fe <sup>2+</sup> và sự hình thành lớp Fe(OH) <sub>3</sub> trên bề mặt. Hợp kim Co–Cr thể hiện mức ăn mòn thấp hơn đáng kể, trong khi titan và vật liệu GC Fuji I gần như không bị ảnh hưởng trong điều kiện thử nghiệm. Động học cho thấy tốc độ ăn mòn tỉ lệ chặt chẽ với quá trình giải phóng oxy từ sự phân hủy H <sub>2</sub> O <sub>2</sub> . Nghiên cứu kết luận rằng các vật liệu nha khoa hiện đại như Co–Cr, titan và GIC có độ bền cao trong môi trường peroxide, trong khi các vật liệu chứa sắt cần được cân nhắc khi sử dụng lâu dài dung dịch sát trùng chứa H <sub>2</sub> O <sub>2</sub> . |
| <b>TỪ KHÓA</b><br>Hợp kim nha khoa<br>Dung dịch hydro peroxide<br>Khả năng chống ăn mòn<br>Phân tích trọng lượng<br>Ăn mòn khử cực oxy |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

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\* Corresponding author. Email: [trungdodinh.vrt@gmail.com](mailto:trungdodinh.vrt@gmail.com)

## 1. Introduction

Hydrogen peroxide, in the form of a diluted aqueous solution, is widely used in medicine and hygiene due to its antiseptic properties. According to the World Health Organization's (WHO) international drug classification system - Anatomical Therapeutic Chemical Classification (ATC) - the active substance is hydrogen peroxide (Hydrogen Peroxide), with code D08AX01. In terms of pharmacological classification, hydrogen peroxide belongs to the group of antiseptics and disinfectants and is used as a solution for local and external use.

In addition to hydrogen peroxide solutions, there are drugs that contain hydrogen peroxide along with carbamide and magnesium peroxides. Some solutions also declare the presence of chlorites, hypochlorites, and salts of dichloroisocyanuric acid [1]. Peroxide-containing drugs are particularly popular as hemostatic and antiseptic agents. According to the authors, there are approximately 40 drug brands on the Vietnamese and Russian medical markets whose active ingredient is hydrogen peroxide. Notably, there are frequent mentions of the benefits of peroxide-containing drugs when taken orally, beyond their common use for disinfecting the oral cavity. However, the potential for corrosion damage to dental prostheses upon contact with peroxides is often overlooked. This study does not aim to evaluate these drugs from a medical perspective but focuses on investigating their effect on dental alloys and assessing the corrosion resistance of alloys upon contact with peroxides.

In recent years, numerous studies have examined the effects of hydrogen peroxide on the corrosion behavior of dental materials. Zhang et al. [2] reported that Ti6Al4V exhibits a time-dependent increase in corrosion rate when exposed simultaneously to  $H_2O_2$  and albumin, primarily due to changes in surface kinetics and redox reactions in simulated physiological environments. These findings align with subsequent electrochemical studies showing that hydrogen peroxide significantly enhances both the anodic and cathodic activity of titanium alloys, resulting in reduced passive-film stability and increased metal dissolution in saline solutions [3] - [5].

For restorative materials, recent studies indicate that peroxide-based bleaching agents can alter the surface roughness, hardness, and composition of glass-ionomer cements, as well as increase ion release into the surrounding environment [6], [7]. Other investigations have noted that strong oxidative conditions induced by peroxide may negatively affect metallic materials such as stainless steel and titanium-based alloys, emphasizing the need for more comprehensive assessments of corrosion behavior across different material classes [8], [9].

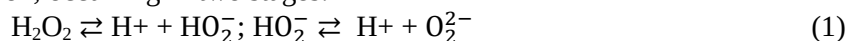
However, most existing research focuses on titanium, stainless steel, or restorative materials, while comparative corrosion data for Co-Cr alloys, titanium, iron-containing materials (such as 30ChGSNA steel), and glass ionomer cements under identical  $H_2O_2$  decomposition conditions remain limited. In particular, the relationship between hydrogen peroxide decomposition kinetics—including pH changes and oxygen evolution—and mass-loss corrosion rates has not been systematically clarified. Therefore, the present study aims to address this gap by simultaneously evaluating corrosion rates, pH variations, and oxygen release in a 3% mass  $H_2O_2$  solution for four representative dental materials.

The aim of this study is to determine the impact of medical drugs containing hydrogen peroxide - recommended for mouth rinsing and oral administration - on the corrosion resistance of dental metal and non-metallic materials. To achieve this goal, the following tasks are proposed:

1. Using the gravimetric method of analysis conduct quantitative studies of the corrosion resistance of metal alloys made from base metals and non-metallic materials commonly used in dentistry, in hydrogen peroxide solutions recommended for oral hygiene.
2. Study the kinetics of pH changes in peroxide-containing solutions and the volume of oxygen released, and estimate the duration of the solution's corrosive aggressiveness.
3. Assess the nature of corrosion damage.

## 2. Materials and Methods

The basis of medical products recommended for oral disinfection is hydrogen peroxide in the form of a 3% mass aqueous solution. In dentistry, 3% mass hydrogen peroxide is commonly used to accelerate recovery after gum surgery, reduce plaque, and decrease the levels of microbial organisms involved in periodontal diseases. Hydrogen peroxide  $\text{H}_2\text{O}_2$  in its pure form is a colorless syrupy liquid with a density of approximately  $1.5 \text{ g/cm}^3$ . Chemically,  $\text{H}_2\text{O}_2$  is a weak acid and a strong base. It is miscible with water in any proportion, and in aqueous solutions, it undergoes weak dissociation, occurring in two stages:



Hydrogen peroxide is unstable and easily decomposes at room temperature into oxygen and water. The presence of certain metals (such as iron, copper, manganese, etc.) accelerates this decomposition. It is important to note that the rate of decomposition increases as the concentration of hydrogen peroxide decreases in the solution [10]. The instability of hydrogen peroxide in an aqueous solution is due to the fragility of the O-O bond; decomposition into water and oxygen occurs according to the following reaction:



Peroxide can be oxidized by the reaction  $\text{H}_2\text{O}_2 - 1e \rightarrow 2\text{HO}^- + \text{H}^+$ , which occurs with a decrease in pH, or it can be reduced by the reaction  $\text{H}_2\text{O}_2 + e + \text{H}^+ \rightarrow \text{H}_2\text{O} + \text{OH}^*$ , which leads to an increase in pH. The multi-stage decomposition process ultimately results in the release of oxygen, which activates corrosion processes [11], [12]. It can be assumed that the corrosion process occurs via mixed depolarization, with oxygen being the dominant factor [13]. The oxygen depolarization mechanism can be schematically represented by the equation:



Carbamide peroxide (urea peroxide), present in a number of antiseptic solutions, decomposes into urea, ammonia, carbon dioxide and hydrogen peroxide (3.35% mass  $\text{H}_2\text{O}_2$  from 10% mass carbamide peroxide). In addition to hydrogen peroxide, there are cases where antiseptic solutions for the oral cavity also contain components such as  $\text{ClO}^-$ ,  $\text{O}^{2-}$ ,  $\text{O}_3$ ,  $\text{HO}^-$ ,  $\text{HO}^{2-}$ ,  $\text{HClO}$  in antiseptic solutions for the oral cavity [14]. Given this composition, it is important to consider the corrosive effect of chlorine in the presence of moisture on dental alloys.

The primary components in base metal alloys for dental prosthetics are chromium, cobalt, and nickel. According to ISO 10271:2020, "Dentistry - Corrosion test methods for metallic materials" (previously ISO 180 6871-01, "Dental metal-based casting alloys"), the content of chromium, cobalt, and nickel in alloys should total at least 85% mass. These elements form the alloy matrix. Chromium is a key component that provides corrosion resistance and strength and is present in all alloys. However, cobalt-chromium dental alloys should not contain more than 29% mass chromium, as a higher chromium content (over 30%) can lead to the formation of a brittle sigma phase, which negatively impacts the alloy's mechanical and casting properties [15].

Nickel-chromium alloys typically contain 23 - 25% mass chromium and exhibit lower chemical resistance compared to cobalt-chromium alloys. The interest in using Co-Cr alloys in dental applications stems from their lower cost and acceptable physical and mechanical properties when compared to nickel-chromium alloys. Furthermore, due to the toxic effects of nickel on the human body, Co-Cr alloys are often used to replace Ni-Cr alloys in base metal applications.

Titanium alloys used in dentistry are biologically safe, have high mechanical properties, biocompatibility, and corrosion resistance. They also exhibit a bactericidal effect and do not interact with the microflora of the oral mucosa. Zirconium alloys are widely used in modern orthopedic dentistry. Zirconium has an advantage over titanium in terms of corrosion resistance and compatibility with biological tissues, and also exhibits an antiseptic effect. Zirconium dioxide ( $\text{ZrO}_2$ ) is comparable to titanium in strength, does not deform over time, and has the ability to restore its structure when microcracks appear.

For the study of non-metallic dental materials, the filling material GC Fuji I (ISO 9917-1) was chosen - a glass ionomer cement (GIC), consisting of glass and an acid component. It hardens through the reaction of silicate glass powder (calcium aluminofluorosilicate glass) and polyacrylic acid, an ionomer. The main components of the cement are silicon dioxide ( $\text{SiO}_2$ ), aluminum oxide ( $\text{Al}_2\text{O}_3$ ) and calcium fluoride ( $\text{CaF}_2$ ). Testing the corrosion behavior of metallic materials for dentistry is complicated by their diversity, the specific features of their application and the specific corrosive environment to which they are exposed in the human oral cavity. As a result, it is difficult to specify a universal test. However, ISO 10271:2020 Dentistry provides detailed procedures for test methods.

In this paper, the corrosion resistance of two dental alloys, an iron-containing alloy and a filling material in a solution for antiseptic treatment of the oral cavity, containing 3% mass hydrogen peroxide  $\text{H}_2\text{O}_2$  as the main active component, was studied. Steel 30ChGSNA was used as the iron-containing alloy. The volume of the reaction mixture for each sample was 10 mL. The tests were conducted in chemical flasks with temperature control; the temperature was maintained at  $+21.5 \pm 0.5$  °C, monitored by thermometers. The total holding time was 40 minutes. The volume of released oxygen was measured using a digital gas volume sensor with a working range of 0 - 400 mL and a measurement error of  $\pm 5\%$ . The acidity of the solution was measured with a digital pH ion meter (2GA-310 Ph/Ion 3310) with a measurement range of 0 - 14, sensitivity of 0.01, and an error of  $\pm 0.1$ .

Using the gravimetric analysis method, the mass corrosion rate was determined for samples of three metal alloys and a filling material in the dental solution. The mass corrosion index was calculated using the formula

$$K_m = \frac{m_0 - m_1}{S \cdot \tau} \cdot \frac{g}{\text{m}^2 \cdot \text{h}}, \quad (4)$$

where  $m_0$  and  $m_1$ , g are the masses of the sample before and after testing; S,  $\text{m}^2$  is the area of the sample;  $\tau$ , h is the test time.

Metal samples were prepared in accordance with GOST 9.905-2007, with sample dimensions of  $30 \times 50$  mm. The surface of the samples was cleaned and processed using R500 sandpaper with a grain size of 20 - 28  $\mu\text{m}$  (GOST 52381-2005). The samples were then degreased with soda ash, washed with distilled water, and weighed on an OHAUS Pioneer electronic analytical scale with a resolution of 0.0001 g and an error of  $\pm 0.0002$  g. The following materials were analyzed: Co-Cr alloy CrC63NBU (Bugodent) (ISO 6871-87), titanium alloy Ti6Al-4V ELI (ISO 5832-3), steel 30 ChGSNA (GOST 4543-71), and filling material GC Fuji I (ISO 9917-1), the composition of which is given in Table 1.

**Table 1.** Chemical composition of the tested materials (% mass)

| Co-Cr alloy CrC63NBU           |                                         |                           |                                          |                          |                           |                  |
|--------------------------------|-----------------------------------------|---------------------------|------------------------------------------|--------------------------|---------------------------|------------------|
| Co<br>64%                      | Cr<br>27%                               | Mo<br>5%                  | Ni<br>3.5%                               | C, Si, Mn<br>rest        |                           |                  |
| Titanium alloy Ti6Al-4V ELI    |                                         |                           |                                          |                          |                           |                  |
| Ti<br>88.09 - 91%              | Al<br>5.5 - 6.5%                        | V<br>3.5 - 4.5%           |                                          | Fe<br>≤ 0.25%            | C, N<br>rest              |                  |
| Steel 30 ChGSNA                |                                         |                           |                                          |                          |                           |                  |
| Fe<br>94%                      | C<br>0.27-0.34%                         | Cr<br>0.90-1.20%          | Ni<br>1.40-1.80%                         | Mn<br>1.00-1.30%         | Si<br>0.90-1.20%          | Cu, S, P<br>rest |
| Glass ionomer cement GC Fuji I |                                         |                           |                                          |                          |                           |                  |
| SiO <sub>2</sub><br>29.0%      | Al <sub>2</sub> O <sub>3</sub><br>16.6% | CaF <sub>2</sub><br>34.3% | Na <sub>3</sub> AlF <sub>6</sub><br>5.0% | AlF <sub>3</sub><br>5.3% | AlPO <sub>4</sub><br>9.8% |                  |

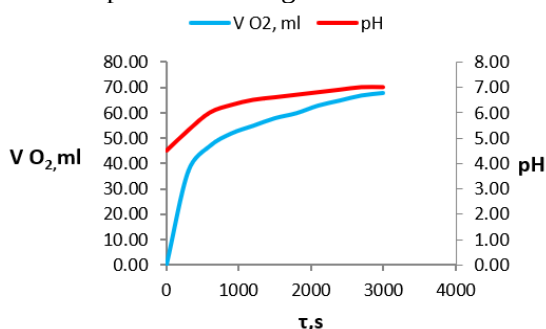
### 3. Results and Discussion

The test results were calculated as the arithmetic mean of five samples. The samples were placed in the test solution and removed at 5-minute intervals for study. They were then cleaned of

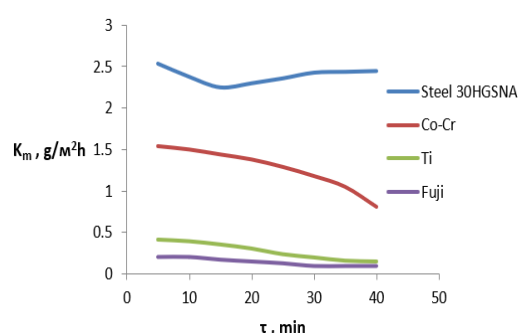
corrosion products using a diluted hydrochloric acid solution with an inhibitor, and any remaining corrosion products were removed with a brush and eraser (GOST 9.905-2007). The samples were washed with distilled water, dried with filter paper, and weighed. The surface of the samples was examined using a Saike Digital SK-HZM technical microscope and photographed. In parallel, the pH of the solutions and the volume of released oxygen were measured. The hydrogen peroxide solutions in which the steel was tested were monitored for the presence of  $\text{Fe}^{2+}$  ions using potassium hexacyanoferrate (III)  $\text{K}_3[\text{Fe}(\text{CN})_6]$ .

During the experiment, it was noted that the pH of the hydrogen peroxide solution increased from 4.5 to 7.0 during 3000 s of exposure to air. Oxygen release is almost complete by this time (Figure 1). As shown in Figure 1, the pH of the solution for corrosion tests increases rapidly from 4.5 to 6.0 during the first 500 seconds, then increases slightly from 6.0 to 6.5 up to 2500 seconds, after which it remains virtually unchanged. From the graph in Figure 1, it can be seen that during the first 500 seconds of the experiment, the volume of released oxygen was approximately 40 mL. In the following period, up to 3000 seconds, the volume increased only slightly compared to the initial stage, accounting for approximately 20% of the total volume. Consequently, the kinetics of the observed values follow the same pattern: a sharp change in pH and oxygen volume occurs in the first 500 seconds, followed by a smooth increase.

The graphs showing the dependence of the mass corrosion index of the studied materials on time are presented in Figure 2.



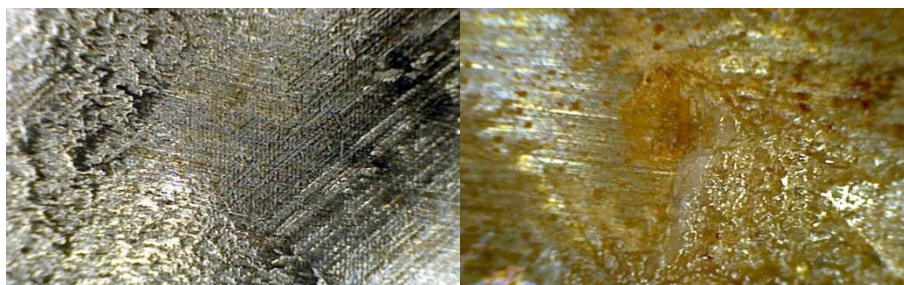
**Figure 1.** Change in pH of the oxygen-evolving peroxide solution over time  $\tau$



**Figure 2.** Change in the mass index of corrosion of dental materials over time  $\tau$

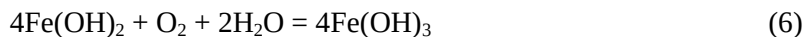
Corrosion products on steel samples can be visually observed after 5 minutes in a hydrogen peroxide solution. After 40 minutes, the entire surface of the sample is covered with yellow-brown corrosion products, indicating the formation of iron (III) hydroxide (Figure 3).

In the first stage of corrosion,  $\text{OH}^-$  ions and  $\text{Fe}^{2+}$  cations are formed, which interact to form white  $\text{Fe}(\text{OH})_2$ . To accurately determine the onset of corrosion, potassium hexacyanoferrate (III) was used as an indicator. Its reaction produced an intense blue color, indicating the presence of iron (II), reaction (5):



**Figure 3.** Corrosion products on steel 30XTCHA after 5 minutes of exposure to hydrogen peroxide solution (left) and after 40 minutes (right) X60

After just 1 minute in the peroxide, the indicator revealed the presence of  $\text{Fe}^{2+}$  confirming the onset of the corrosion process. Subsequently, under the influence of oxygen,  $\text{Fe}(\text{OH})_2$  oxidizes to brown  $\text{Fe}(\text{OH})_3$ .



Thus, during the test, there is an intense release of oxygen due to the decomposition of hydrogen peroxide, which has two consequences: on the one hand, the oxidation of  $\text{Fe}^{2+}$  to  $\text{Fe}^{3+}$  according to reaction (6) accompanied by the accumulation of excess oxygen, which accelerates the cathodic reaction of the corrosion process; on the other hand, the formation of  $\text{Fe}(\text{OH})_3$  shields the surface, preventing the intensive development of corrosion.

From the graph of the corrosion rate of steel (Figure 2), it can be seen that the corrosion rate decreases slightly, reaching a minimum around the 20th minute, then increases again. This behavior of the mass indicator can be explained by the formation of corrosion products on part of the surface: these products accumulate and hinder cathodic dissolution, but as mixing occurs due to the release of oxygen, they peel off and transition into the solution. As a result, the surface of the sample is cleared of corrosion products, leading to an increase in the corrosion rate. By the end of the exposure time, the growth of the corrosion rate slows down, not reaching the initial values, which corresponds to a decrease in oxygen release due to the completion of peroxide decomposition. The overall effect of hydrogen peroxide's interaction with iron is the rapid decomposition of hydrogen peroxide, with the intermediate formation of active oxygen species. Ultimately, oxygen and water are formed by reaction (2). The cobalt-chromium alloy (Figure 2) exhibits greater corrosion resistance than steel. As a result, the corrosion rate decreases during the experiment, and by the end, it is approximately three times lower than that of steel. Titanium alloy and glass ionomer restorative cement (GC Fuji I) are virtually immune to corrosion in a peroxide environment. Although there is data suggesting a decrease in the strength of cement in a hydrogen peroxide environment, our study did not show any signs of corrosion destruction through gravimetric analysis.

#### 4. Conclusion

Based on the testing a number of dental materials used in treatment and prosthetics for corrosion resistance in medical antiseptic solutions containing hydrogen peroxide, the following conclusions are drawn: Hydrogen peroxide solution decomposes rapidly in open air, releasing oxygen. The duration for intensive decomposition of the studied concentration of hydrogen peroxide was approximately 500 seconds, during which the chemical and corrosion activity is confined to this time interval. Modern metal alloys based on titanium, cobalt, and chromium demonstrate high corrosion resistance in hydrogen peroxide solution. Non-metallic glass ionomer cements are not affected by the hydrogen peroxide solution.

Iron-containing alloys corrode at a high rate in a hydrogen peroxide environment. It was observed that the corrosion kinetics of iron-containing alloys and the kinetics of hydrogen peroxide decomposition follow similar patterns. This suggests that oxygen released during the decomposition of hydrogen peroxide plays a dominant role in the corrosion process. Therefore, with regular use of peroxide-containing antiseptic and bleaching medical solutions, it is important to consider the potential corrosive effects on dental alloys containing iron-based components.

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## REFERENCES

- [1] N. V. Shestopalov, L. G. Panteleeva, N. F. Sokolova, I. M. Abramova, and S. P. Lukichev, "Federal Clinical Guidelines for the Selection of Chemical Disinfectants and Sterilizers for Use in Healthcare Organizations," Ministry of Health of the Russian Federation, Moscow, 2015.
- [2] Y. Zhang, O. Addison, F. Yu, B. C. R. Troconis, J. R. Scully, and J. Davenport, "Time-dependent enhanced corrosion of Ti6Al4V in the presence of H<sub>2</sub>O<sub>2</sub> and albumin," *Scientific Reports*, vol. 8, 2018, p. 3185.
- [3] L. Benea and N. Simionescu, "Impact of hydrogen peroxide and albumin on the corrosion behavior of titanium alloy (Ti6Al4V) in saline solution," *International Journal of Electrochemical Science*, vol. 16, no. 2, 2021, Art. no. 210244, doi: 10.20964/2021.02.39.
- [4] I. H. Elshamy, S. S. Abd El Rehim, M. A. Ibrahim, and N. F. El Boraei, "The bifunctional role played by thiocyanate anions on the active dissolution and the passive film of titanium in hydrochloric acid," *Corrosion Engineering, Science and Technology*, vol. 57, pp. 542-552, 2022.
- [5] F. L. L. de Camargo, A. C. Lancellotti, A. F. de Lima, V. R. G. Martins, and L. de S. Gonçalves, "Effects of a bleaching agent on properties of commercial glass-ionomer cements," *Restorative Dentistry & Endodontics*, vol. 43, no. 3, 2018, doi: 10.5395/rde.2018.43.e32.
- [6] K. Ganesan, C. Hayagreevan, A. J. Jeevagan, *et al.*, "Candle soot derived carbon dots as potential corrosion inhibitor for stainless steel in HCl medium," *Journal of Applied Electrochemistry*, vol. 54, pp. 89-102, 2023.
- [7] L. Benea and N. L. Bogatu, "Electrochemical corrosion assessment of 316L stainless steel for dental structures in saliva solution," in *Proceedings of the 2022 E-Health and Bioengineering Conference (EHB)*, 2022, doi: 10.1109/EHB55594.2022.9991580.
- [8] M. N. Yilmaz and P. Gul, "Effect of carbamide peroxide treatment on the ion release of different dental restorative materials," *BMC Oral Health*, vol. 24, no. 1, 2024, doi: 10.1186/s12903-024-04876-5.
- [9] N. F. El Boraei, M. A. M. Ibrahim, S. S. Abd El Rehim, and I. H. Elshamy, "Electrochemical corrosion behavior of  $\beta$ -Ti alloy in a physiological saline solution and the impact of H<sub>2</sub>O<sub>2</sub> and albumin," *Journal of Solid State Electrochemistry*, vol. 28, pp. 2243-2256, 2024.
- [10] M. L. Kremer, "The Fenton reaction. Dependence of the rate on pH," *Journal of Physical Chemistry A*, vol. 107, pp. 1734-1741, 2003.
- [11] I. I. Yurasova, N. I. Yurasov and D. A. Sulegin, "Study of potassium dichromate-catalyzed hydrogen peroxide decomposition," *Herald of the Bauman Moscow State Technical University, Natural Sciences*, no. 5, pp. 125-135, 2016.
- [12] A. S. Guzenkova, D. Q. Hieu, S. A. Guzenkov, and S. V. Belskiy, "Corrosion resistance of dental alloys in aqueous hydrogen peroxide solutions," *Russian Military Medical Academy Reports*, vol. 44, no. 2, pp. 167-174, 2025, doi: [10.17816/rmmar678731](https://doi.org/10.17816/rmmar678731).
- [13] A. S. Guzenkova, S. A. Guzenkov, and S. S. Ivanov, "Modern methods for studying corrosion processes," in *Resistance of Materials to External Influences: Proceedings of the III All-Russian Scientific and Practical Conference*, Khimki, 2021. Khimki: Civil Defense Academy of the Ministry of Emergency Situations of Russia, 2022, pp. 55-62.
- [14] C. J. Tredwin, S. Naik, N. J. Lewis, and C. Scully, "Hydrogen peroxide tooth-whitening (bleaching) products: Review of adverse effects and safety issues," *British Dental Journal*, vol. 200, no. 7, pp. 371-376, 2006.
- [15] Abdurakhmanov and Kurbanov, *Materials and Technologies in Orthopedic Dentistry*, Moscow: Meditsina, 2008.