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SEM OF CORRODED NDFEB MAGNETS IN A CULTURE MEDIUM

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INTRODUCTION

Rare earth magnets, such as neodymium-iron-boron, are nowadays produced in small enough dimensions that allow their use in dental applications. One of their widespread use in dental applications is as retentive devices for overdentures, mainly due to their retentive force and compactness [1]. The main problems associated with the use of this type of magnets in clinical use are corrosion and wear. Due to wear of the can, saliva is able to leak into the can and cause corrosion of the magnet. The cytotoxicity of the corrosion products leached into the body fluids is not yet known. The aim of this study was to investigate the corrosion behavior of a commercial neodymium-iron-boron magnet when in contact with physiological medium by means of SEM and EDS, to analyze the corrosion products leached into that medium by neutron activation analysis (NAA) method and the toxicity of those products.

MATERIALS AND METHODS

A commercial neodymium-iron-boron magnet provided by Crucible (Crumax) whose composition is given elsewhere [2] has been used. The surface was prepared by grinding with silicon carbide paper up to #1000. Subsequently, the magnet was immersed in a cell culture medium: minimum Eagle's medium (MEM) for two periods, 48 hours and 10 days. After each period, the magnet's surface was observed by SEM and the corrosion products analyzed by EDS. The extract (culture medium and corrosion products) of each period was tested for cytotoxicity. NAA of the corrosion products was performed in the extract where the magnet was kept immersed for 48 hours.

RESULTS

Figures 1 and 2 show SEM micrographs of the magnet that have been exposed for 48 hours to the culture medium. Localized corrosion, such as pitting (figure 2), was observed. Accumulation of corrosion products occurred at some areas (figure 3) and EDS at the corroded area, indicated the presence of chloride related to it. Co, Fe and Nd were found in the analyses of extract. As the time increased, the corroded area of the magnet and the amount of corrosion products in the culture medium also increased After immersion of the magnets in a cell culture medium at 37° C, either for 48 hours or 10 days , the cytotoxicity assay showed no toxicity.

DISCUSSION AND CONCLUSION

Corrosion initiation was likely due to the chlorides in the culture medium leading to localized corrosion. The corrosion products formed were not protective, and corrosion continued as the time increased. Although the corrosion products showed no toxicity the magnet should be very well encapsulated to avoid corrosion by the physiological fluids.

ACKNOWLEDGEMENTS

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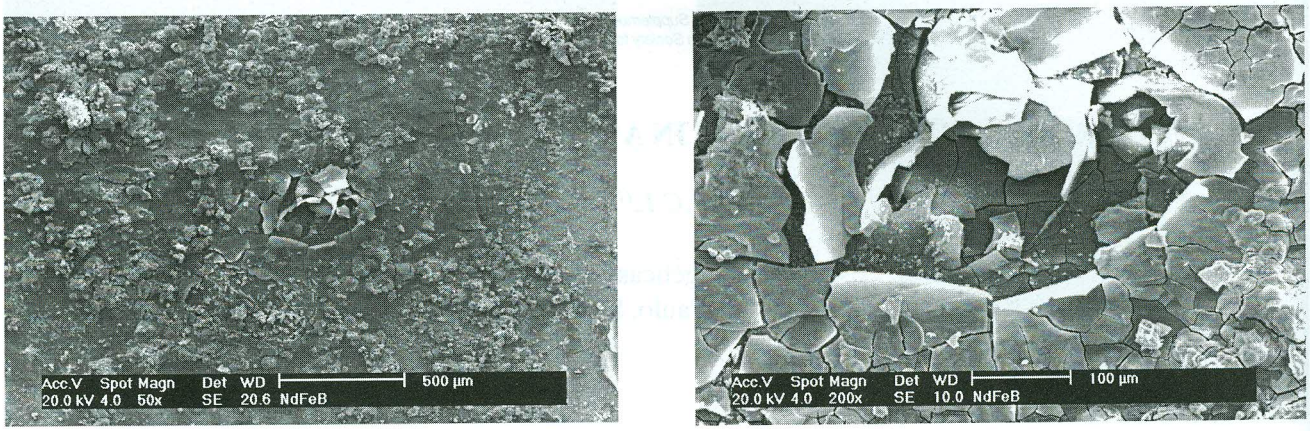

(a) (b)

Figure 1. (a) SEM of the surface of NdFeB magnet exposed to the culture medium for 48 hours showing localized corrosion, (b) enlargement of the area with localized corrosion.

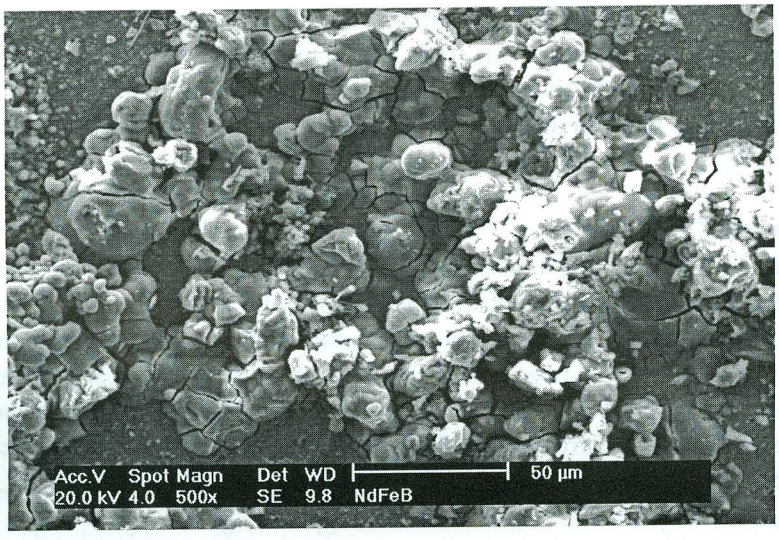

Figure 2. SEM of corroded area showing the accumulation of corrosion products at localized areas.

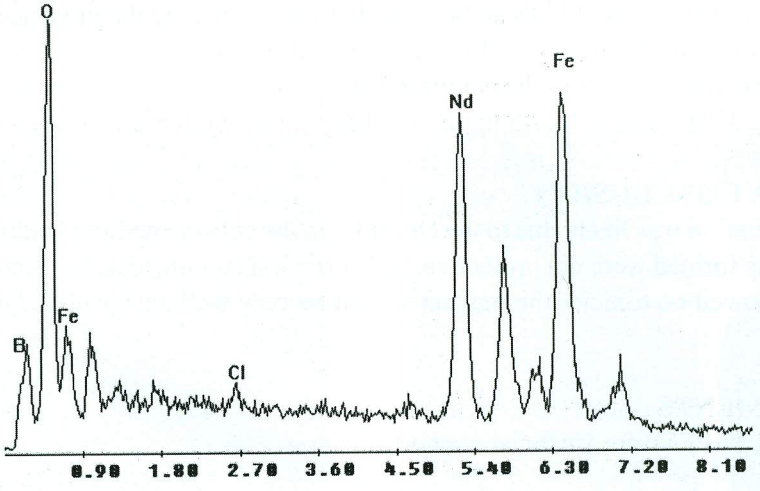

Figure 3. EDS of region shown in figure 2, showing the presence of Cl related to the corroded area.