

A Review on Surface Coatings of Aluminium Implants

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Abstract

This research paper is the visualisation of research trends in the surface coating of Aluminium implants using Review analysis. This research will help to understand the active authors, organizations, journals, and countries involved in the research of “surface coating of Aluminium implants”. All published articles related to “surface coating of Aluminium implants” from “Scopus”, were analyzed using the Meta Analysis to develop analysis tables and visualization maps. This article had set the objective to consolidate the scientific literature regarding “surface coating of Aluminium implants” and also to find out the trends related to the same. The leading Journals were the Journal of Biomedical Materials Research and Surface coating Technology. The most active country was the United States of America. The leading organization engaged in research regarding the surface coating of Aluminium implants was the Chinese Academy of Sciences, China. The most active authors who had made valuable contributions related to the surface coating of Aluminium implants Liu X and Cook.S.D.

Keywords: Aluminium implants, Surface coating, Material engineering, Review analysis, Meta Analysis,

1. Introduction

Aluminium and Aluminium oxides are used for medical implants and for preparing medicines. Moreover, both Aluminium and Aluminium oxides are used as a coating for various medical implants. Similarly, Aluminium implants are also surface coated with other materials for enhancing their performance. The major challenge associated with Aluminium oxide implants is corrosion of the Aluminium implants (Bayer, Tiwari and Megaridis, 2008); the allergy or hypersensitivity; and toxicity; high level of serum Aluminium level (Grübl *et al.*, 2006) and lead to various complicated health issues.

Aluminium implants can be better protected through coating with multi-layers. Such coatings can be good measures against corrosion. Advances in nano engineering can be employed for this purpose (Andreeva and Skorb, 2014). The performance of Aluminium-based implants can be enhanced by nano-diamond composite coatings on Aluminium (Blum and Molian, 2009). Graphite powders were also used to enhance the performance of Aluminium implants by reducing premature failure of implants in low-temperature degradation. Improved surface finishing of implants and enhanced performance can be conducted through Nano crystalline oxide coatings on Aluminium implants (Curran, 2012). Similarly, positive bone responses had been obtained from titanium aluminium nitride coating on medical implants (Freeman and Brook, 2006).

Both material engineering and surface engineering can play a significant role in improving the performance and life of Aluminium-implants along with measures for reducing toxicity and hypersensitivity of the metal. This Review analysis will be a useful platform for future researchers by realizing the top researchers, organizations, and countries involved in research regarding surface coating of Aluminium-implants.

This article is arranged into four sections. The first section is the introduction, followed by the discussion of the methodology by which the research was conducted. The third section deals with results and discussion. The fourth section deals with the conclusion. The following research objectives and research questions were framed for conducting Review analysis systematically.

1.1 Research Objectives

- a) To consolidate the literature regarding surface coating of Aluminium implants
- b) To find out the trends related to research in the surface coating of Aluminium implants

1.2 Research Questions

- a) Who are the active researchers working on the surface coating of Aluminium implants?
- b) Which are the main organizations and countries working on the surface coating of Aluminium implants?
- c) Which are the main journals on the surface coating of Aluminium implants?

2. Research Methodology

Scopus files had been used for this article. For the article selection, the Boolean used was TITLE-ABS (Aluminium implant coating). All the tables in this paper were created by using Microsoft Excel and Meta Analysis. Grammarly was used for spelling and grammar checks. Mendeley was used for article review and citation. This paper had been inspired by Review analysis in its presentation style, analysis, and methodology from the works.

3. Results and discussion

3.1 Results

This first round of search produced an outcome of 1101 documents, in 11 languages, out of which 1058 documents were in English. The classification of document categories is shown in Table 1. For improving the quality of the analysis, we had selected only the peer-reviewed articles and all other documents had not been considered. Thus after using filters “Article” and “English” the second round search produced an outcome of 793 English articles (both open access and others) and had been used to conduct Review analysis and visualization using Meta Analysis. The English research articles in this domain since 1973 had been shown in Figure 1.

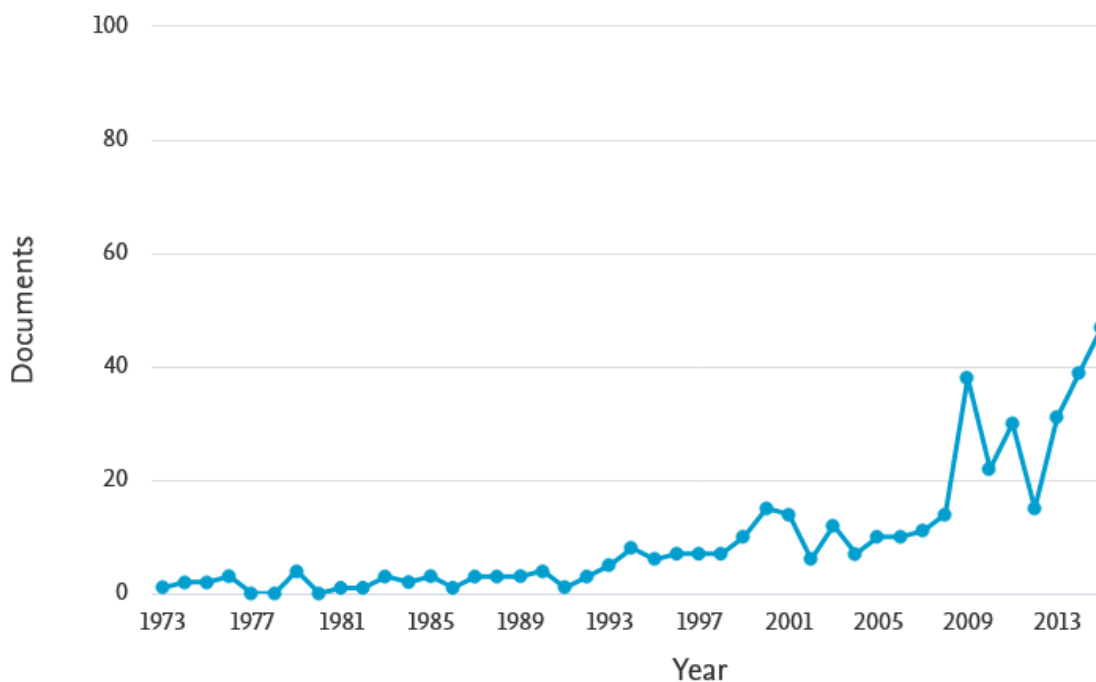


Figure1: Period wise publication of articles,

Co-authorship analysis of top authors had been shown in Table1. For a better presentation of the analysis, the parameters used were the minimum number of documents of an author as five and the minimum number of citations of authors as one. This combination plotted the map of 34 authors, in 13 clusters. The overlay visualization map of co-authorship analysis plotted in Table1, points out the major researchers with their strong co-authorship linkages and clusters involved. The citation analysis of top authors had been shown in table 1. For the citation analysis, the parameters used were the minimum number of documents of an author as two and the minimum citations of an author as one.

Table 1: Highlights of most active authors

Description	Authors	Documents	Citations	Average citations per documents	Link strength
Authors with the highest publication and links	Liu X	11	251	23	46
Authors with the highest citations	Cook.S.D	7	447	64	15

In Co-occurrence analysis, we had used all keyword analyses, by keeping the minimum number of occurrences of a keyword as 100. This combination plotted the map of 32 thresholds, in two clusters. The overlay visualization of co-occurrence analysis of keywords has been shown in Table2. The leading organizations engaged in research on “surface coating of implants” had been found out by the volume of publications and citation analysis, the parameters used are the minimum number of documents of an organization as one and the minimum number of citations of organizations as one. The leading organization in the research regarding “surface coating of implants”, with the highest number of publications and citations, was the Chinese Academy of Sciences, China (Refer to table 2).

Table 2: Highlights of the most active organization

Organizations	Country	Documents	Citations	Average Citations per document
Chinese Academy of Sciences	China	30	697	23.2

Co-authorship analysis of the countries engaged in the research on “surface coating of Aluminium implants” had been shown in Table3. The overlay visualization map of co-authorship analysis plotted in Table3, points out the main countries with their strong co-authorship linkages and clusters involved. The citation analysis of top countries had been shown in table 3, along with co-authorship links. For the citation analysis, the parameters used were the minimum number of documents of a country as one and the minimum citations of the country as one.

Table 3: Highlights of Active Countries

Description	Country	Documents	Citations	Link strength
The country with the leading publication, citations, and co-authorship links	United States of America	153	4829	85

The most active country in this research domain was the United States of America, with the highest number of publications, and citations.

This paper had highlighted the most active journals by using the parameters of the minimum number of documents of a journal as one and the minimum number of citations as one. Highlights of the most active and relevant journals related to “surface coating of Aluminium implants” are shown in table 4. Table 4 shows the journal activity of this research domain through parameters of publication volume and citations.

Table 4: Analysis of journal activity

Description	Journal details	Documents	Citations	Average citations per documents	Links
Journal with the highest publications and links	Surface coating Technology	61	1062	17.4	59
Journal with the highest citations	Journal of Medical Materials Research	41	2392	58.3	51

From the above discussion regarding the Review patterns in the research regarding surface coating of Aluminium implants, this research had observed a gradual increase in research interest regarding surface coating of Aluminium implants from the starting of the millennium, and the momentum is going on positively. This points out the relevance and potential of this research domain (Refer to Table 2). The most active authors in this research domain were Liu X and Cook.S.D. with the highest publication and links; and citations respectively (Refer to table 1). The overlay analysis of top countries researching surface coating of Aluminium implants indicates that the United States of America was the leading country relating to the highest number of publications and citations (Refer to Table 5). The top journals of this research domain were identified as the Journal of Biomedical Materials Research and Surface coating

Technology. From these wide sources of information, researchers can focus on top journals where they can identify the most relevant and highly cited articles regarding surface coating of Aluminium implants.

4. Conclusion

Surface coating of Aluminium implants was an interesting research domain and the most active journals related to this research domain was the Journal of Biomedical Materials Research and Surface coating Technology. The most active country was the United States of America. The leading organization engaged in research regarding the surface coating of Aluminium implants was the Chinese Academy of Sciences, China. The most active authors who had made valuable contributions related to the surface coating of Aluminium implants Liu X and Cook.S.D. with the highest publication and links; and citations respectively. This research domain offers a new avenue for researchers and future research can be on innovations in the surface coating of Aluminium implants.

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