



# TOPIC OF RESEARCH

Experimental Analysis Of Composite  
Materials For Bio Medical  
Applications.

# Objectives

- To develop the non-infected biomaterial for vascular knee & various bone joints.
- To produce low density, light weight non-corrosive material
- To achieve metal mechanical and morphological characteristics for biomedical applications.

# Scope

- Wide range of engineering materials where required for the biomedical application
- Due to low density of magnesium alloy it has been under investigation as on implant material both in cardiovascular and orthopedic application
- The recent trend in the alloying and development of magnesium matrix composite have been discussed in details in past decade.

# Literature Review (Cont..)

1. “Recent Developments in Magnesium Metal–Matrix Composites for Biomedical Applications: A Review” Sourav Dutta, Sanjay Gupta, and Mangal Roy\* July 26, 2020. The authors stated that different types of reinforcement materials with magnesium and its behavior with natural bone material.
2. “Fabrication of Magnesium Metal Matrix Composites Reinforced with Fly Ash Cenospheres” Priyanka V. Kadam, Vidyadhar Kale, © 2020 IJCRT | Volume 8, Issue 7 July 2020. the authors stated that Composite materials are versatile in terms of constituent selection so that the properties of the materials can be modified. Addition of reinforcing materials such as rice husk, fly ash cenosphere, machining chips, Al<sub>2</sub>O<sub>3</sub>, SiC, B<sub>4</sub>C, metallic glass, etc., is one of the ways to enhance various mechanical properties of Mg based MMCs. The cost-effective methodology of composite materials is, therefore, an essential element for expanding their applications. This is especially true for the high performance magnesium materials due to certain unique characteristics of composites which offer effective approaches to strengthen the properties of magnesium alloys.

# Literature Review

3. “Corrosion and tribological behavior of magnesium metal matrix hybrid composites- A review” Ravikumar Saranu, Ratnam Chanamala, and Srinivasa Rao Putti, AIP Conference Proceedings 2259, 020018 (2020); the authors stated that on the recent literature survey, mechanical behavior, tribological properties relates to Mg-based metal matrix composites. Magnesium Metal Matrix Hybrid Composites (MMMHC) is applied in various productions such as vehicle industries and aerospace. The material has good corrosion resistance. Moreover, performance of the material basically depends on correct the combination of reinforcement material. They also reviewed for enhancing the consequence of corrosion and tribological properties of hybrid composites like AZ91E, Fly ash, and Silicon Carbide (SiC). The paper ends that composite material has high corrosion resistance and high wear resistance.
4. “Effects of processing conditions on solidification characteristics and mechanical properties of in situ magnesium metal matrix composites derived from polysilazane precursor” Nagaraj M Chelliah, Padaikathan Pambannan, and MK Surappa. The authors stated that Polymer-derived in situ magnesium metal matrix composites (P-MMMCs) were fabricated by injecting a liquid or crosslinked polysilazane precursor into molten magnesium by a stir-casting method at two different melt temperatures of 700 and 800C. Microstructural analysis reveals that the composites fabricated at 700C exhibit uni-modal grain size distribution having more or less columnar-shaped grain morphology.

# Literature Review

5. “Investigation of graphene-reinforced magnesium metal matrix composites processed through a solvent-based powder metallurgy route” V Kavimani, K Soorya Prakash and Titus Thankachan, Bull. Mater. Sci. (2019) 42:39. The authors investigated that AZ31 alloy is homogeneously reinforced with 0.2, 0.3, 0.4 and 0.5 wt% of reduced graphene oxide (r-GO) nano sheets for the first time through a series of methodologies involving solvent processing, mechanical alloying, cold pressing and finally sintering under argon atmosphere at 560°C. The attained results show that amongst the others, addition of 0.4 wt% r-GO have obviously improved the hardness up to 64.6 HV and also yielded a better inhibition efficiency of 84% on corrosion. Any further increase of r-GO content resulted for significant decrease in the wear rate up to the level of 2.6 mm<sup>3</sup> Nm<sup>-1</sup>..
6. “Evaluation Of Mechanical Properties of Mg Alloy/SiC/Graphite Hybrid Metal Matrix Composites Using Desirability Approach” N. Nafeed, P Loganathan ,S.Ranganathan and C.Thiagarajan, International Journal of Pure and Applied Mathematics Volume 119 No. 12 2018, 15619-15627. They evaluated and concluded that The influence of process parameters on friction force of Mg- 7.5 wt% SiC and -7.5wt% Gr hybrid composites was investigated using the desirability approach. By using this new mathematical model, the dry sliding metal to metal contact wear of Mg/SiC/Gr hybrid composites containing 7.5 wt% volume fraction and size of reinforcement can be predicted at 95% confidence level. The accuracy of the predicted values has been improved by considering the number of experimental conditions.

# Summary of Literature

- Matrix & Reinforcement preparation procedure
- Fabrication procedure
- Testing evaluation methodology
- Analysis & optimization are identified based on literature survey.
- The better effective way of matrix composite development were studied.
- Significance of mechanical properties were studied.

# Research Proposal (Cont..)

**Title: Mechanical morphological characteristics of magnesium matrix composite for biomedical applications.**

- Recently, there is a growing interest in developing magnesium (Mg) based degradable biomaterial. Although corrosion is a concern for Mg, other physical properties, such as low density and Young's modulus, combined with good biocompatibility, lead to significant research and development in this area.
- This research will specifically focus on recent developments in Mg-based metal matrix composites (MMCs) for biomedical applications. Much effort will be given into finding suitable bioactive, bioresorbable reinforcements and processing techniques that can improve upon existing materials.
- In summary, this research will provide a comprehensive overview of existing Mg-based composite preparation and their mechanical and corrosion properties and biological responses and future perspectives on the development of Mg-based composite biomaterials.

# Research Proposal (Cont..)

1. Matrix Selection



2. Reinforcement material selection



3. Fabrication methodology



4. Required testing evaluation

Compressive test, Impact test, Hardness test, Microstructure Analysis (SEM, TEM, XRD...), Corrosion resistance test, ETAX Analysis (Chemical)



5. Analysis & Validation.

# Novelty in Research Proposal

- Now a days titanium based matrix were used for biomedical application from past decade
- But the effective non-infected magnesium matrix is going to be developed for the replacement of titanium matrix due to low cost, low density, mechanical and chemical characteristics.

# References

1. “Recent Developments in Magnesium Metal–Matrix Composites for Biomedical Applications: A Review” Sourav Dutta, Sanjay Gupta, and Mangal Roy\* July 26, 2020.
2. “Fabrication of Magnesium Metal Matrix Composites Reinforced with Fly Ash Cenospheres” Priyanka V. Kadam, Vidyadhar Kale, © 2020 IJCRT | Volume 8, Issue 7 July 2020. | ISSN: 2320-2882.
3. “Corrosion and tribological behavior of magnesium metal matrix hybrid composites- A review” Ravikumar Saranu, Ratnam Chanamala, and Srinivasa Rao Putti, AIP Conference Proceedings 2259, 020018 (2020).
4. “Effects of processing conditions on solidification characteristics and mechanical properties of in situ magnesium metal matrix composites derived from polysilazane precursor” Nagaraj M Chelliah, Padaikathan Pambannan, and MK Surappa.
5. “Investigation of graphene-reinforced magnesium metal matrix composites processed through a solvent-based powder metallurgy route” V Kavimani, K Soorya Prakash and Titus Thankachan, Bull. Mater. Sci. (2019) 42:39.
6. “Evaluation Of Mechanical Properties of Mg Alloy/Sic/Graphite Hybrid Metal Matrix Composites Using Desirability Approach” N. Nafeed, P Loganathan ,S.Ranganathan and C.Thiagarajan, International Journal of Pure and Applied Mathematics Volume 119 No. 12 2018, 15619-15627.

# References

7. “Microstructure and Mechanical Properties of Magnesium Matrix Composites Interpenetrated by Different Reinforcement” Shuxu Wu, Shouren Wang, Daosheng Wen, Gaoqi Wang and Yong Wang; Appl. Sci. 2018, 8, 2012; doi:10.3390/app8112012.
8. “Wear Behaviour of Magnesium Metal Matrix Composites Fabricated By Powder Metallurgy Process” Satish J, Satish K G; ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887, Volume 6 Issue III, March 2018.
9. “Study on Fabrication of Magnesium based Metal Matrix Composites and its improvement in Mechanical and Tribological Properties- A Review”, D. Dash, S. Samanta, R. N. Rai; IOP Conf. Series: Materials Science and Engineering 377 (2018) 012133.
10. “ Magnesium Matrix Composites Machining Aspects: A Review”, Mustafa M. ABDULGADIR, Bilge DEMİR, International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056 Volume: 04 Issue: 04 | Apr -2017.
11. “Mechanical Performance of Magnesium Composites Containing Hybrid Al<sub>2</sub>O<sub>3</sub> Reinforcement”, E Suneesh, M Sivapragash; International Journal of Civil Engineering and Technology (IJCIET) Volume 8, Issue 8, August 2017, pp. 365–378, Article ID: IJCIET\_08\_08\_037.