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A Review Study on Recent Advancements in the field of Biomaterials Like Magnesium-Hydroxyapatite Matrix Composites

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Abstract

In this era the composite materials and their applications are become a debate subject for both the composite engineers as well as for the materials scientists. Among the composites materials the biomedical composites materials has become a demanding material for its applicable in the field of biomedical areas. Various biomedical composites have been discovered and manufactured like mg-calcium polyphosphate (CPP) matrix composites, mg-Fluorapatite (FA) nanocomposites, and other magnesium-hydroxyapatite matrix composites. Among these biomedical composite materials, mg-hap matrix composite is in major demands in medical industry for its biodegradable properties and advanced mechanical, thermal and various other properties. In this paper various biomedical composite materials, their properties and fabrication processes have been discussed in details.

Keywords: Magnesium, Hydroxyapatite, Biodegradable Materials, Biodegradable Matrix Composites.

1. Introduction

Composite engineers and materials scientists have been debating the meaning of composite materials in recent days. Biomedical engineers are now frequently using the term composite to describe newly created biomaterials. [1]

Biomedical Composite Material:-Material for Biomedical Composites: A biomedical composite material is described as a material made up of two or more physically or chemically different, adequately organised or dispersed constituents separated by an interface for biomedical purposes. It has been features that are not reflected by any of the components in isolation, with the objective of mixing materials being these unique properties.

The real essence of the concept of composites is: The matrix is a continuous phase in composite materials, whereas the reinforcement is a dispersed, non-contiguous phase that generally outperforms the matrix in terms of mechanical and thermal characteristics.

The bulk phase accepts the load across a vast surface area, which is the core of the composites principle. [1]

Classification:-The following are the most important aspects that affect the composite's engineering performance: -

1. Materials used to manufacture individual components

2. The components' quantity, shape, and placement

3. Component interaction

The matrix material employed in composite materials may also be used to classify them widely. Polymer-matrix composites (PMCs), ceramic-matrix composites (CMCs), and metal-matrix composites are the three types of composites (MMCs). The last kind is a high-temperature advanced composite that is rare in biological applications.

Selection Parameters For Biomaterials:-Host Response, Biocompatibility, Bio functionality, Functional Tissue Structure and Path Biology, Toxicology, Appropriate Design and Manufacturing, Mechanical Properties of Biomaterials, High Corrosion Resistance, High Wear Resistance, Long Fatigue Life, Adequate Strength, Modulus equivalent to that of bones are some of the selection parameters for biomaterials. [32]

Magnesium Alloys as Biodegradable Materials:-Magnesium alloys have received a lot of interest recently as a new type of biodegradable material. The functionality, cost, and environmental impact of the materials used in biomedical implantation should all be considered. Magnesium as a cast iron, aluminium, and polymer substitute is being researched at a lightning speed.

Table- Properties of Magnesium Matrix Material:-

Material	Magnesium
Phase	Solid
Density	1.783 g/cm^3
Melting Point	650 ^{O}C
Boiling Point	1091 ^{O}C
Heat of vaporization	128 kJ/mol
Heat of fusion	8.48 kJ/mol

[24]

Biodegradable Magnesium Matrix Composites:-Trauma, disease, and resumption may all cause fractures in bone, which is a composite natural living tissue. Bone is made up of 30 percent matrix, 60 percent mineral, and 10 percent water as a composite. In fracture procedures, metals with good body compatibility, such as stainless steel, Ti, and Pt, has typically been used as implants. The primary disadvantage of these metallic materials is that they are not always biodegradable; necessitating a surgical procedure to remove them from the patient's body once they have healed. This is not ideal because of the dangers (infection and problems) connected with surgery, as well as the lengthier recuperation time, longer inpatient stay, and greater health-care expenditures.

1. Magnesium–hydroxyapatite matrix composites
2. Biodegradable Mg/Fluorapatite (FA) nanocomposites
3. Biodegradable Mg–calcium polyphosphate (CPP) matrix composites
4. Biodegradable HAP + β-TCP/Mg-Ca composite
5. Biodegradable Tricalcium phosphate /Mg matrix composites

Magnesium–hydroxyapatite matrix composites:-

Hydroxyapatite (HAP), a naturally occurring mineral type of calcium apatite with the formula Ca5(PO4)3(OH), is widely recognised for its poor solubility and outstanding bioactivity and biocompatibility in the human body environment. It possesses chemical and structural characteristics that are comparable to those of bone and teeth minerals. Because the HAP has a low load bearing capability, it cannot be used in biological applications by itself. HAP particles, on the other hand, can be employed as reinforcing materials in Mg-based MMCs for biomaterials. To obtain the required and optimal characteristics, adding a small proportion of HAP particles as reinforcement to the Mg Matrix would be a better alternative. Ball-mill rolling, stir casting, or powder metallurgy are all used in the production of MG-HAP composites in various quantities.[25]

Methods Used:- Stir Casting, Die casting, Powder Metallurgy, Ball roll mill processing etc.

Fig- Stir Casting Machine Setup

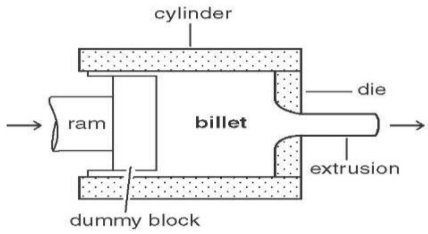

Fig- Extrusion Machine

Applications:-

1. The biomaterials have been used for Bone Screw.
2. The biomaterials have been used for Bone Plates.
3. The biomaterials have been used for Bone Pins.
4. The biomaterials have been used for teeth implants.
5. The biomaterials have been used for knee implants
6. The biomaterials have been used for orthopaedic surgery.
7. The biomaterials have been used for femoral knee.
8. The biomaterials have been used for femoral hip.
9. The biomaterials have been used for tibial components.
10. The biomaterials have been used for acetabular cup etc. [34]

Key Benefits of Mg:-

Biocompatible, biodegradable, bioresorbable, same density and young's modulus of bone (E=10-30GPa), less tress shielding effect, and light weight are some of the advantages of magnesium. Low density-Mg density of 91.783 g/cm3 is similar to cortical bone (1.75-2.1 g/cm3), High specific strength-strength to weight ratio of approx.130kNm/kg, High damping capacity, High Machinability and dimensional correctness, Low Stress shielding, Good Biocompatibility, Good Degradation, and so forth. [34]

Major draw backs of Mg:-

Biomaterials that generate hydrogen upon breakdown have lower corrosion resistance. Low elastic modulus, rapid decomposition, and high hydrogen evolution- The emitted H2 gas accumulates at a rapid pace in the surrounding soft tissues. Hydrogen evolution rates of 0.01 ml/cm2 have been observed for several Mg alloys comprising Zn, Al, and Mn. [34]

Table- Mechanical properties of different tissues compared with current biomedical magnesium alloys and traditional biomaterials:-

Tissue/Material	Density/(g.cm3)	Ultimate Tensile Strength/Mpa	Yield Strength/Mpa	Compressive Yield Strength/Mpa	Elastic Modulus/Mpa	Elongation/%
Cancellous bone	1.0-1.4	1.5-38	_	_	10-1570	_
Arterial wall	_	0.50-1.72	_	_	1	_
Cortical bone	1.8-2.0	35-283	104.9-114.3	164-240	5_23	1.07-2.10
Synthetic HA	3.05-3.15	40-200	_	100-900	70-120	_
DL-PLA	_	29-35	_	_	1.9-2.4	_
Mg-1Ca-extruded	_	239.6	135.6	_	_	10.6
Mg-cast	1.74	86	20.9	_	41	13
Ti6Al4V	4.43	830-1025	760-880	_	114	12
AZ91D-die cast	1.81	230	150	160	45	3
LAE442	_	247	148	_	_	18
AZ31-extruded	1.78	235	125-135	60-70	45	7
AM60B-die cast	1.78	220	_	130	45	6_8
WE43-extruded	1.84	280	195	_	44	10
Mg-Zn-Mn-extruded	_	280.3	246.5	_	_	21.8

2. Literature Review

S.F.Hassan et al. (2002) The research work used a novel fragmented melt deposition approach followed by hot extrusion to create elemental and titanium particle reinforced magnesium composites. The composite samples' micro structural analysis revealed a rather homogeneous dispersion of titanium particles in the matrix material. The inclusion of titanium as reinforcement enhances the dimensional stability of pure magnesium, according to physical property analysis. The addition of titanium reinforcement resulted in a 0.2 percent increase in yield strength and ductility, whereas the UTS was negatively impacted. [37]

E. Salernitano et al. (2003) investigated and analyzed the different mechanical, corrosion, and thermal characteristics of various composite materials for bio-medical applications such as implantation of human tissues, bones, tendons, skin, ligaments, teeth, and so on. [15]

L. Lu et al. (2004) The effects of reinforcements on the strength of Mg9 percent Al composites produced using powder metallurgy route were investigated. The insertion of TiB2 reduced mechanical qualities such as yield stress; however the usage of ZrB2 and SiC reinforcements improved mechanical properties. [23]

C. S. Goh et al. (2005) Using the powder metallurgy process, researchers generated unique carbon nanotube reinforced magnesium nanocomposites. The physical and mechanical characteristics of the Mg nanocomposites were also studied, and increasing the number of CNTs in the Mg nanocomposites resulted in a greater improvement in heat stability. [10]

Z.Fan (2005) established the rheo-casting (RDC) method for magnesium alloys, a new one-step semisolid processing approach for creating high integral components from Mg-alloys, and assessed the porosity as 0.1-0.3 percent, as well as microstructure, strength, and ductility. [50]

Mark P Staiger et al. (2006) Magnesium and its alloys were investigated for their qualities as biocompatible, osteoconductive, and degradable implants for load-bearing orthopaedic applications. [29]

Chenglong Liu et bal. (2007) The effect of heat treatment on the breakdown behavior of biodegradable die-cast AZ63 magnesium alloy in simulated bodily fluid was examined. The heat treatment method was also used to study the alloy's microstructure. The alloy's corrosion resistance is improved by its homogenous microstructure, and the optimum corrosion rate obtained on the matured sample is almost half that of the untreated alloy. [11]

Frank Witte et al. (2007) MMCs, which are constructed of magnesium alloy AZ91D as a matrix and hydroxyapatite as filler, were investigated (HA). Different composite materials including hcp-Mg, Mg17Al12, and HA were examined for mechanical and corrosion characteristics. [17]

Frank Feyerabend et al. (2007) investigated and analysed the different mechanical, corrosion, and thermal characteristics of various composite materials for bio-medical applications such as implantation of human tissues, bones, tendons, skin, ligaments, teeth, and so on. [15]

Witte F et al. (2007) By changing the distribution of HA particle size and content, biodegradable magnesium-hydroxyapatite metal matrix composites were examined and explored for their mechanical, corrosive, and cytocompactible characteristics. [42]

W.L.E.Wong et al.(2007) Magnesium composites containing various proportions of nano-size Cu particles were effectively manufactured utilising a powder metallurgy (PM) approach that included microwave aided two-directional sintering in this work. Physical, micro structural and mechanical characteristics of sintered specimens were studied using hot extrusion. The existence of a continuous network of nano-size Cu particles and Mg Cu intermetallics phase adorning the particle boundaries of the metal matrix was discovered by micro structural analysis. With the addition of nano-size Cu particles, the CTE value of the magnesium matrix was somewhat enhanced. The inclusion of nano-size Cu particles increased the matrix's hardness, elastic modulus, 0.2 percent yield strength (YS), ultimate tensile strength (UTS), and work of fracture. [43]

X.L. Zhong et al. (2007) A powder metallurgy approach was used to effectively produce nano-size aluminium powder (Alp) reinforced magnesium composites. The materials' micro structural analysis indicated a very uniform distribution of reinforcement. The inclusion of aluminium nanoparticles at a concentration of 1 vol. percent increases the hardness, yield strength, and ultimate tensile strength of magnesium. When compared to pure magnesium, the composites' average ductility was greater at 0.75 vol. percent and then dropped. [46]

Frank Witte et al. (2008) investigated numerous magnesium corrosion-based experiments on degradable biomaterials. For the aim of implantation in the human body. [16]

M. H. Fathi et al. (2008) Mechanical alloying (MA) production and bioactivity testing of nanocrystaline fluoridated hydroxyapatite were investigated (FHA). The synthesised FHA was studied using a variety of methods including X-ray diffraction (XRD), Fourier transform infrared (FTIR), Transmission electron microscopy (TEM), scanning electron microscopy (SEM), and ICP-OES analysis. [27]

Asit Kumar Khanra et al. (2009) By using various chemical synthesis processes, the microstructure and mechanical properties of Mg-HAP composites were developed, and their characteristics were checked using X-ray diffraction (XRD) and scanning electron microscope (SEM), and their theoretical and experimental hardness was compared with the addition of HAP. [2]

Liping Xu et al. (2009) A phosphating technique was used to test the surface bioactivity of a calcium phosphate coated magnesium alloy in vitro and in vivo (Ca-P coating). For the purpose of promoting early bone formation at the implant/bone interface. [22]

M. Habibnejad-Korayem et al. (2009) The Stir-casting process was used to investigate the improved mechanical characteristics of Mg-based nano-composites reinforced with Al2O3 nano-particles as compared to pure Mg and AZ31 magnesium alloy. [26]

Asit Kumar Khanra et al. (2010) performed various property studies on extruded Mg-HAP and ZM61-HAP composites by melting and extrusion process on ZM61 matrix consisting of 93 wt% Mg, 6 wt% Zn, and 1 wt% Mn and various quantities of chemically produced HAP powder (0,5,10,15 wt percent). [3]

M. Razavi et al. (2010) the use of metal matrix composites based on magnesium alloys was investigated. Magnesium-fluorapatite nanocomposites for biomedical applications: production and characterisation Using the blending-pressing-sintering process, magnesium-fluorapatite nanocomposites were created. The mechanical, metallurgical, and in vitro corrosion characteristics were all investigated. [28]

M.Razavi et al. (2010) A blend-press-sinter powder metallurgy (PM) process was used to create novel AZ91-FA nanocomposites (with 10%, 20%, and 30% FA). The generated AZ91-FA nanocomposites, as well as the AZ91 magnesium alloy as a control sample, were assessed for microstructure, mechanical characteristics, and bio-corrosion behaviour. The addition of FA nanoparticles in the AZ91 magnesium alloy matrix improved the hardness and elastic modulus significantly, according to the findings. The yield strength of the AZ91-FA nanocomposites with 20 wt. percent FA nanoparticles was the greatest, and the ductility of the AZ91-FA nanocomposites declined as the FA content increased. [30]

Xuenan Gu et al. (2010) Using the powder metallurgy (PM) process, Mg/HA (10 wt. percent, 20 wt. percent, and 30 wt. percent) composites were made from pure magnesium and hydroxyapatite (HA) powders. These Mg/HA composites were investigated in terms of microstructure, mechanical properties, corrosion, and cytotoxicity. The primary constitutional phases of Mg/HA composites were simply -Mg and HA, according to the results. The yield tensile strength of Mg/10HA composites was higher than that of as-extruded bulk pure magnesium, but the yield tensile strength, ultimate tensile strength, and ductility of Mg/HA composites dropped when the HA percentage was increased. The rate of corrosion of Mg/HA composites increased as the HA content rose. [45]

Xue-Nan GU et al. (2010) the mechanical, bio corrosion, and biocompatibility features of magnesium alloys and composites were investigated for usage as biodegradable materials for bone tissue implants. [47]

Ailing Feng et al. (2011) Powder metallurgy was used to create magnesium alloy (ZK60A) matrix composites reinforced with 2.5, 5, 7.5, and 10% calcium polyphosphate particles that were sphere-like in form and averaged 750 nm in size. The composites were studied for their microstructure, mechanical characteristics, and degradation behaviour in physiological saline. For composites containing 2.5 and 5 wt. percent calcium polyphosphate, the obtained findings reveal that ultrafine calcium polyphosphate particles disperse equally in the ZK60Amatrices without voids. When the calcium polyphosphate concentration is increased from 0 to 5 wt. percent, ultimate tensile strengths, yield strengths, and elastic moduli of the composites tend to rise. The composites have strong mechanical qualities and may degrade at a controlled rate, making them suitable for use as load-bearing bone implants. [4]

Ailing Feng et al. (2011) Powder metallurgy is used to make the calcium polyphosphate (CPP) reinforced ZK60A magnesium-matrix composites. The microstructure, mechanical, and corrosion characteristics of composites are examined in this work. The CPP particles are evenly dispersed throughout the composite, and the CPP–matrix interface is well defined. The composites have a 20-weight-percentage-point content. The highest compressive strength of CPP was 494.88 MPa. During compressive testing, effective load transmission from matrix to particle results in particle breakage. CPP addition lowered the composites' ultimate strength and yield strength, according to tensile testing. [5]

Z.G.Huan et al. (2011) has investigated the ZK30-bioactive glass composites utilising powder metallurgy and semi solid casting methods to compare different features such as micro-porous architectures and particles, as well as corrosion resistance qualities, for usage in orthopaedic applications as a biodegradable material. [51]

A. H. Yusop et al. (2012) studied the porous biodegradable metals for hard tissue scaffolds. The biodegradable metal scaffolds has shown that mechanical property that was very close to the human bone.[6]Porous biodegradable metals for hard tissue scaffolds were investigated. The mechanical properties of biodegradable metal scaffolds were found to be extremely similar to those of human bone. [6]

Dharam Persaud Sharma et al. (2012) Due to their degradable properties, biodegradable magnesium alloys have been researched for use in the wound healing process. [13]

Debao Liu et al. (2012) A unique melt shearing method combined with a high-pressure die-casting (HPDC) process was used to create the biodegradable nano-sized -TCP/Mg composite. The effects of different mixing procedures on the distribution material of -TCP particles were also looked at. [14]

Nitesh R. patel et al. (2012) the breadth, uses, and human anatomical importance of a wide range of biomaterials such as metals, polymers, ceramics, and composites were investigated for the purpose of implantations in the human body for speedy healing purposes. [32]

Ting Lei et al. (2012) By employing a stir reaction to prepare a powder combination of pure magnesium and 20wt percent ZnO as a raw material, researchers investigated the varied corrosion behaviour of biodegradable Mg-based metal matrix composites (MMC) that were reinforced by MgO ceramics and Mg-Zn intermetallics. [41]

X. wang et al. (2013) Suction casting was used to infiltrate MgCa alloy into porous HA + -TCP, resulting in unique interpenetrating (HA + -TCP)/MgCa composites. Scanning electron microscopy (SEM), X-ray diffraction (XRD), mechanical testing, electrochemical testing, and immersion tests were used to assess the microstructure, mechanical characteristics, and corrosion behaviours of the composites. The composites were found to have a compact structure and excellent interfacial bonding between the MgCa alloy and the HA + -TCP scaffolds. The composites' ultimate compressive strength was around 500–1000 times that of the porous scaffolds, yet it still only had a fourth of the strength of the bulk MgCa alloy. [44]

B. Ratan Sunil et al. (2014) The production and mechanical behaviour of degradable magnesium-hydroxyapatite implants with a lamellar structure were investigated using a powder metallurgy technique. When the HA concentration was raised, the study discovered that it had a significant impact on corrosion and mechanical properties. [7]

Y.F. Zheng et al. (2014) The microstructure, mechanical properties, and biodegradation behaviours of various biodegradable metals (BM) such as pure Mg, Mg-Cu alloy, Mg-Zn alloy, and other Fe, Ca, and Sr based alloys were evaluated in vitro and in vivo performances, as well as pre-clinical and clinical trials for implantation purposes. [48]

Yunchang Xin et al. (2014) a filtered cathodic arc deposition technique is used to form a ZrN/Zr bilayered coating on AZ91 magnesium alloy in this research. The ZrN/Zr bilayered structure buffers the substrate-to-ZrN coating mismatch, enhancing film adherence. X-ray diffraction (XRD) and X-ray photoelectron spectroscopy are used to assess the coating composition (XPS). Using a potentiodynamic polarisation test and electrochemical impedance spectroscopy, the electrochemical behaviour of the coated alloy is investigated in detail (EIS). [49]

Cesar Augusto Stupp et al. (2015) Biodegradable Mg-Hydroxyapatite composites for biomedical applications were explored through powder metallurgical synthesis. In this study, magnesium metal matrix composites (Mg-MMC) were investigated, which were made up of ZK60 as a base material and hydroxyapatite (HA) particles. [9]

Reece N. Oosterbeek et al. (2015) As an alternate strategy to managing magnesium corrosion rate, a hybrid composite structure comprising magnesium metal and a biopolymer was produced in this work. To construct a hybrid composite structure that is topologically organised in all three dimensions, a multistep procedure combining metal foam manufacturing and injection moulding was created. Preliminary studies of the hybrid Mg-polymer composite structures' mechanical characteristics and corrosion behaviour offer a new possible approach to the development of Mg-based biomedical devices. [35]

Bin Chen et al. (2016) The AZ91 Magnesium alloy/porous hydroxyapatite composite was investigated for its possible use in bone healing. The investigation discovered that the melted AZ91 alloy thoroughly penetrated the HA perform without altering its porous structure. [8]

H.R.Zheng et al. (2017) Addition of MgO surface modified tricalcium phosphate ceramic nanoparticles increased the mechanical characteristics and corrosion resistance of magnesium alloy composites (m-b-TCP). High shear mixing technique was used to create Mg-3Zn-0.8Zr composites including both unmodified (MZZT) and modified (MZZMT) nanoparticles. Microstructure, mechanical characteristics, electrochemical corrosion properties, and cytocompatibility of Mg-Zn-Zr/b-TCP composites were studied using MgO m-b-TCP nanoparticles. MZZMT grain size was half that of MZZT after hot extrusion deformation and dynamic recrystallization, and m-b-TCP particle distribution in the matrix was more uniform than b-TCP particle distribution. MZZMT had better yield tensile strength (YTS), ultimate tensile strength (UTS), and corrosion potential (Ecorr) than MZZT, but lower corrosion current density (Icorr). [20]

Junxiu Chen et al.(2017) The impact of heat treatment on the biodegradability of ZK60 alloy was examined in this work. The T5 and T6 treatments, as well as as-cast and as-extruded ZK60 alloys, were investigated. Microstructure analysis, electrochemical measurement, and an immersion test were all performed. The development of tiny and evenly distributed MgZn phases enhanced both mechanical characteristics and degrading behaviour following T5 treatment. Corrosion resistance was likewise high in the as-cast metals. [21]

N. Aboudzadeh et al. (2017) The nanocomposites of Mg. 5Zn.0.3Ca/Nha produced by powder metallurgy at varied percentages of 0,1,2.5, and 5% wt were investigated. For the micro structural testing of the nanocomposites, an XRD analysis was performed, followed by a SEM test. The compressive strength and density profile were also measured. [33]

R Radha et al. (2017) The strategies for increasing the mechanical and degradation performance of Mg alloys by correctly modifying the mix of alloying elements, reinforcements, and processing procedures are detailed in this paper. It also discusses the state and development of research on I nutrition element selection for alloying, reinforcing, and effects, Mg alloy systems (binary, ternary, and quaternary) and composites, grain refinement for strengthening by severe plastic deformation procedures. [34]

Sina Naddaf Dezfuli et al. (2017) Due to their efficient control over their physiochemical and mechanical reactions when in contact with physiological fluids, researchers investigated the creation of improved bredigite-containing magnesium-matrix composites for biodegradable bone implant applications. The effects of these composites were assessed using cell attachment, cytotoxicity, and bioactivity assays. [36]

Sameer Kumar D. et al. (2017) The manufacture and characterisation of magnesium alloys (AZ91E) based nano-composites including nano Al_2O_3 particulate composites were investigated utilising a unique semi solid stir casting process. [39]

Lakshmanan Pillai et al. (2017) studied magnesium-based matrix materials supplemented with TiO_2 particles at various ratios such as 2.5, 5,7.5, and 10%. Powder metallurgy is used. The mechanical parameters were assessed, and improvements in density, hardness, and tensile strength were found to be 13.8 percent, 17.8 percent, and 29 percent, respectively. Scanning electron microscopy was also used for micro structural investigation (SEM). [24]

Meysam Haghshenas (2017) The mechanical characteristics of biodegradable magnesium matrix composites (MMC) such as Mg-HAP, Mg-Zn, Mg-Ca, and Mg-REE were investigated, with an emphasis on tensile strength, elastic modulus, ductility, and corrosion resistance. [25]

Chen Liu et al. (2018) Magnesium alloys were investigated as possibly biodegradable, biocompatible, and osteoconductive metallic materials that might be employed in bone repair due to their degradability and mechanical qualities that are similar to bone. [12]

Nurettin Sezer et al. (2018) According to their degrading properties and lack of implant removal after fixation in the body, researchers explored several magnesium-based biomaterials and their uses for implantations in human bodies. This research looked at a variety of mechanical qualities, biocompatibility, and degradation behaviour. [31]

Francis Nturanabo et al. (2019) Aluminium metal matrix composites (AlMMCs), which have qualities of light weight, high stiffness, and moderate strength, were examined for a variety of unique applications. The development, application, and future potential of AlMMCs in different industrial and commercial applications are reviewed in this study, as well as the current hurdles that are preventing their full market penetration. [19]

Somasundaram Prasadh et al. (2019) Magnesium (Mg)-based materials have lately been investigated by the biomedical community as viable materials for mandibular reconstruction due to its superior mechanical characteristics, biocompatibility, and degradability. This article examines current advancements in the development of Mg-based materials for mandibular restoration, as well as the biomechanics of the mandible and the many sorts of abnormalities. Mechanical properties, corrosion properties, and in vivo performance of magnesium-based materials are reviewed. [40]

3. Conclusion

According to the literature, today's biomaterials include in metals are as tantalum, Ti6Al4V, gold, titanium alloys, Co-Cr alloys and 316L stainless steel as well as in polymers are as Poly lactic acid (PLA), Silicone Rubber (SR), Polymethylmethacrylate (PMMA), Ultra high molecular weight polyethylene(UHMWPE), Polyurethane(PE),Polyethylene Terepthalate (PET), Polytetrafuoroethylene (PTFE), Polyetheretherketone (PEEK),Polyurethane (PU), Polyacetal (PA), Polysulfone (PS)as well as inceramics are as bio glass, alumina, titania, zirconia, carbonhydroxyapatite (HA) and in composites are as CF/PTFE, CF/C, CF/UHMWPE, Al_2O_3/PTFE, HA/PE, Silica/SR, CF/PEEK, CF/epoxy.According to the literature, Mg alone cannot be used as a biomaterial; therefore, a metal matrix composite (MMC) must be developed by adding hydroxyapatite (HAP) to Mg alloy so that its composite can be successfully used for biomedical implants after some changes in Mg's corrosion and degradable properties by changing the contents of HAP to enhance corrosion resistance, biodegradability, and mechanical properties, among other things. This research work will aid in the development of a Metal Matrix Composite (MMC) of Mg-HAP material using traditional as well as modern techniques and methods in a cost-effective manner, as well as the enhancement of microstructural, corrosion resistance, and mechanical properties through various experiments and analysis processes, so that the material's microstructure, corrosion resistance, and mechanical properties can be improved for use in the biomedical implantation and other clinical applications as an alternate source of existing biomaterials.

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