Title: Magnesium-rich Multi Principal Element Alloy (Mg-MPEA)

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KEYWORDS: MPEA, Magnesium alloy, Orthopedic, Genetic Algorithm, Machine Learning
DOMAIN: Material Science

SUMMARY:

The new class of biomedical alloy i.e. multi-principle element alloy emerged as an ideal alternative to the existing biomedical alloys, where the base alloy contains several metal elements. The development of a refined MgNbTiZn-based MPEA comprises four biologically active metals—Magnesium (Mg), Zinc (Zn), Titanium (Ti), and Niobium (Nb) in an optimized proportion ($Mg_aNb_bTi_cZn_d$). To obtain a preferred alloy composition, a novel optimization technique has been performed including a genetic algorithm and machine learning-based phase prediction.
Mg and Zn are classified as bioresorbable metals, while Ti and Nb are categorized as bioinert metals. As a result, the material showcases remarkable mechanical strength, minimal degradation over time, and biodegradability within the in-vivo environment.

ADVANTAGES:

1. Cost-effective material relative to the traditional MPEAs due to the utilization of economical metals.
2. The alloy exhibits mechanical properties (Compressive strength, Elastic Modulus) similar to those found in human bone.
3. Improved and reduced corrosion rate (0.38 mm per year).
4. Lightweight in nature with a density value of 2.81gm/cm3.

APPLICATION: Mg-rich MPEA can be used in orthopedic applications such as bone scaffolds, boneplates, screws, biomedical devices, etc.

SCALE OF DEVELOPMENT: The material is developed and tested at a lab scale.

TECHNOLOGY READINESS LEVEL: TRL 3

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