





# Mathematical modeling of biodegradation of metal implants in orthopedics

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# **Research Objective**

- Goal:
  - Tuning the degradation of the implant to the regeneration of the new bone
- Will be achieved by:

Building a mathematical framework for the assessment of biodegradation



# Methodology



Open source solvers

# **Mathematical Model**

The model captures:

- 1. The chemistry of dissolution of metallic implant
- 2. Formation of a protective film
- 3. Effect of ions in the medium



#### 2D Mg Scaffold – Film Formation



# 2D Mg Scaffold – Film Formation



#### 2D Mg Scaffold – Film Formation





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# 3D Mg Scaffold - Degradation





# 3D Mg Scaffold – Mg<sup>2+</sup> Release





#### **Model Validation**

Validation has been done using experimental immersion test data



#### Conclusion

- A quantitative mathematical model to assess the degradation behavior of biodegradable metallic implants in silico
- Once fully validated, the model will be an important tool to find the right design and properties of the degradable implants

# Thank you for your attention

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