HIGH ENTROPY ALLOYS AGAINST EXTREME CONDITIONS FOR SATELLITAL MATERIALS

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INTRODUCTION

Satellite Orbits:

- Low Earth Orbit
- Medium Eart Orbit
- Geostationary Earth Orbit

Extreme conditions such as:

- High energy radiation
- Heat and cold cycling
- Ultra vacuum
- Atomic oxygen

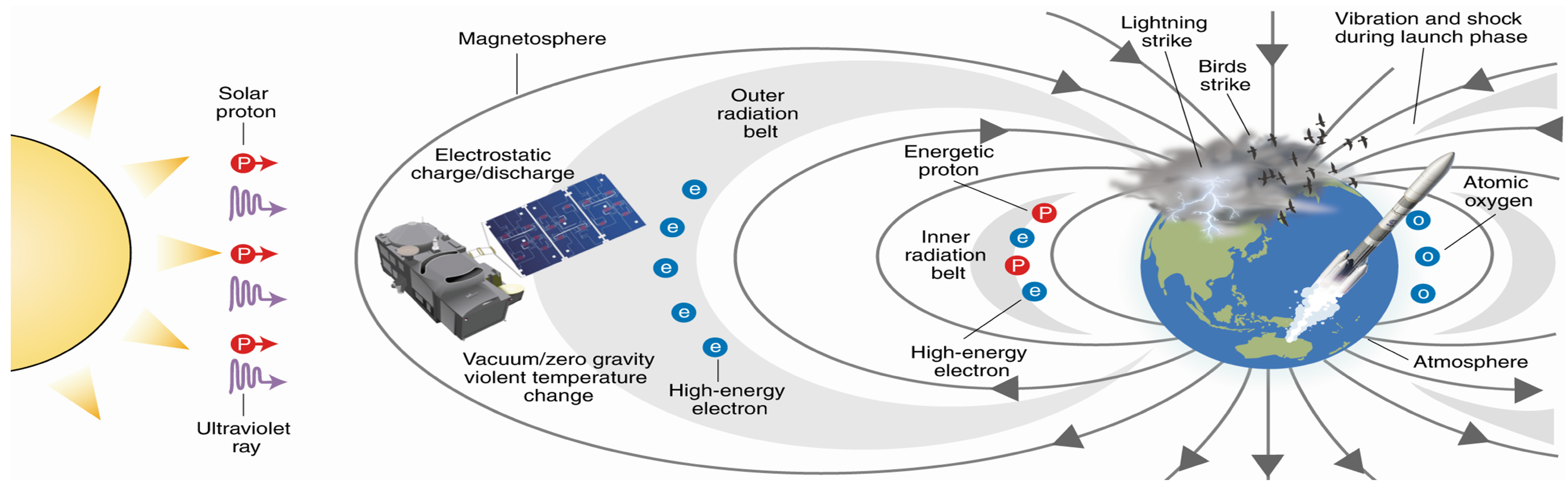

Figure 1. Extreme conditions in space

BACKGROUND

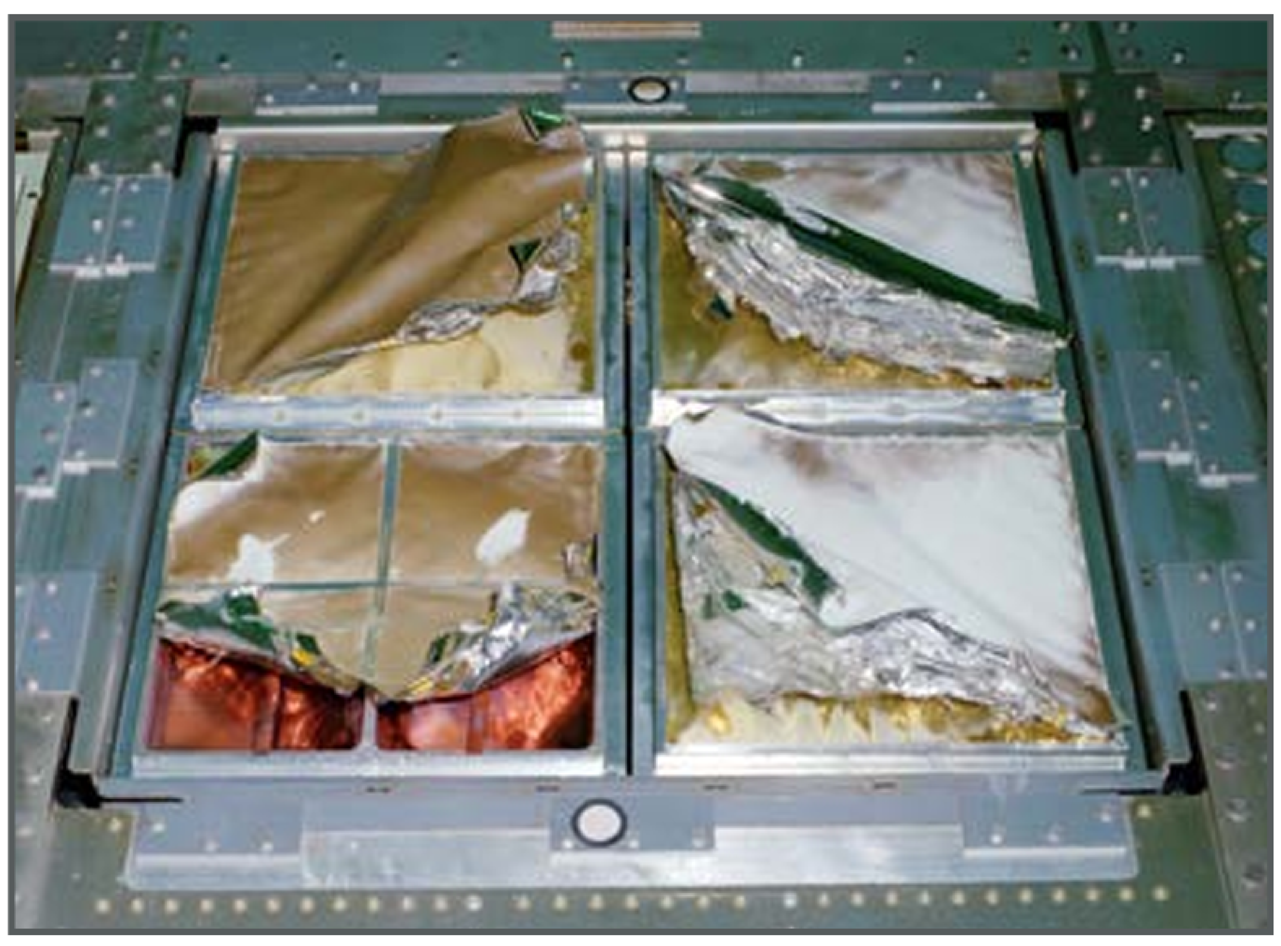

Figure 2. Postflight Long Duration Exposure Facility M0001 Heavy Ions in Space experiment

Satellite Structure

- Engine
- Solar Panels **(most vulnerable)**
- Antenna System
- Protective Covering

Solar Panels are made of:

- Conventional Aluminum Alloys
- Honeycomb Arrays

GRADE	ALLOY	FEATURES
1000 series	99% pure aluminium	Electrically conductive
2000 series	Copper	Increased strength
3000 series	Manganese	Food safe
4000 series	Silicon	Lower melting point
5000 series	Magnesium	Higher corrosion resistance
6000 series	Magnesium and silicon	Respond well to heat treatment
7000 series	Zinc	High strength

Alloy	Al%	Mg%	Si%	Cu%	Mn%	Zn%	Cr%	Fe%	Ti%
5052	97.7	2.8	0.25	0.1	0.1	0.1	0.35	0.4	-
6061	98.6	1.2	0.8	0.4	0.15	0.25	0.35	0.7	0.15
7075	91.4	2.9	0.4	2.0	0.3	6.1	0.28	0.5	0.2

Figure 3. Classification of aluminum alloys and their composition

PROPOSAL

The use of High Entropy Alloy coatings will improve the durability of solar panels exposed to satellite orbit

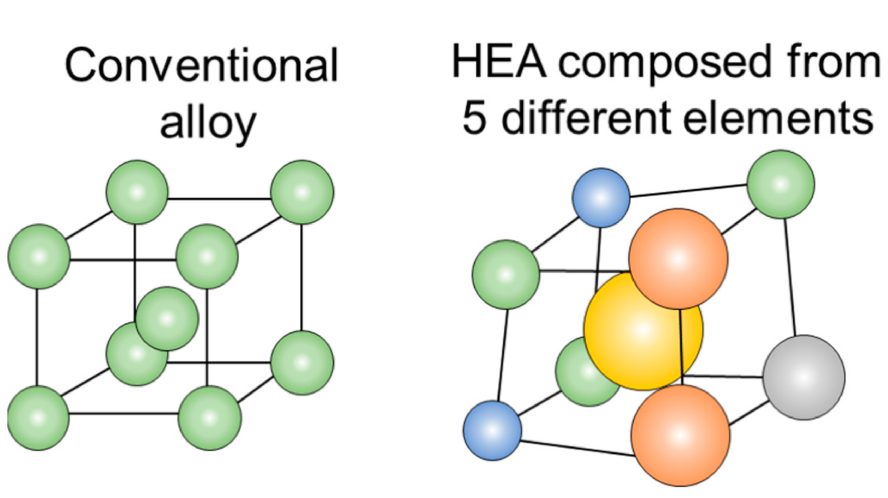

Figure 4. Conventional vs High entropy alloys

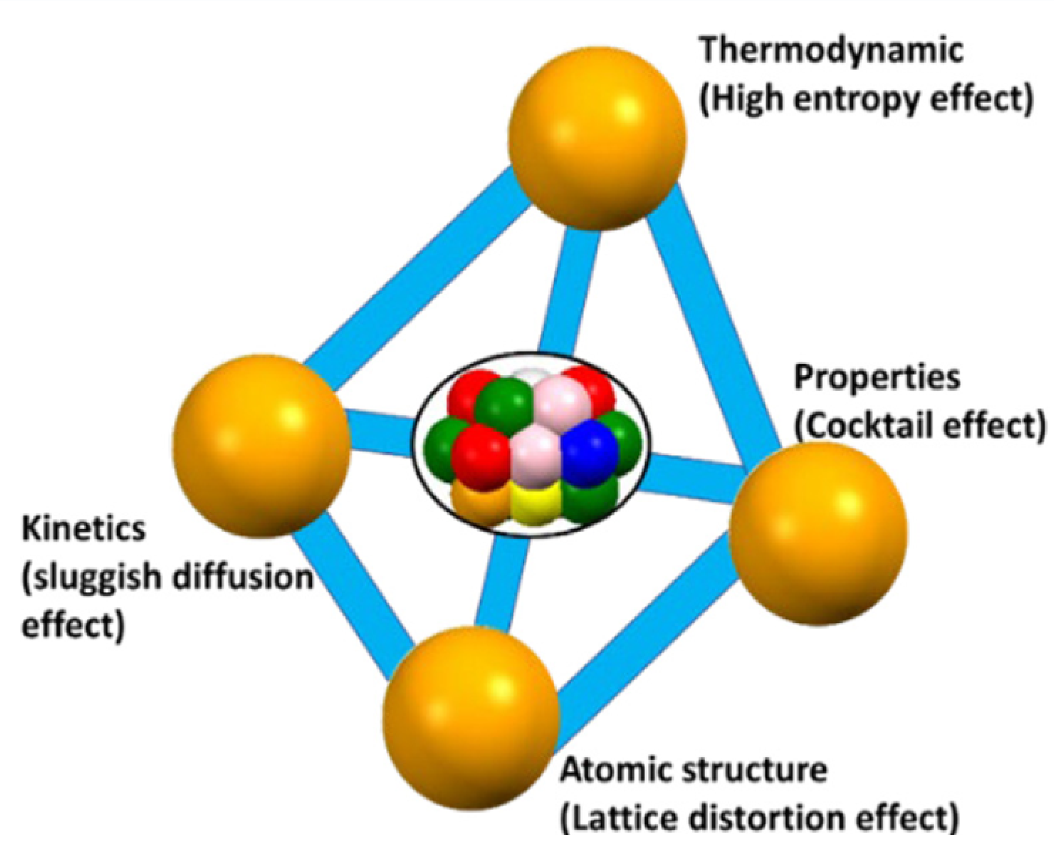

Figure 5. Characteristics of high entropy alloys

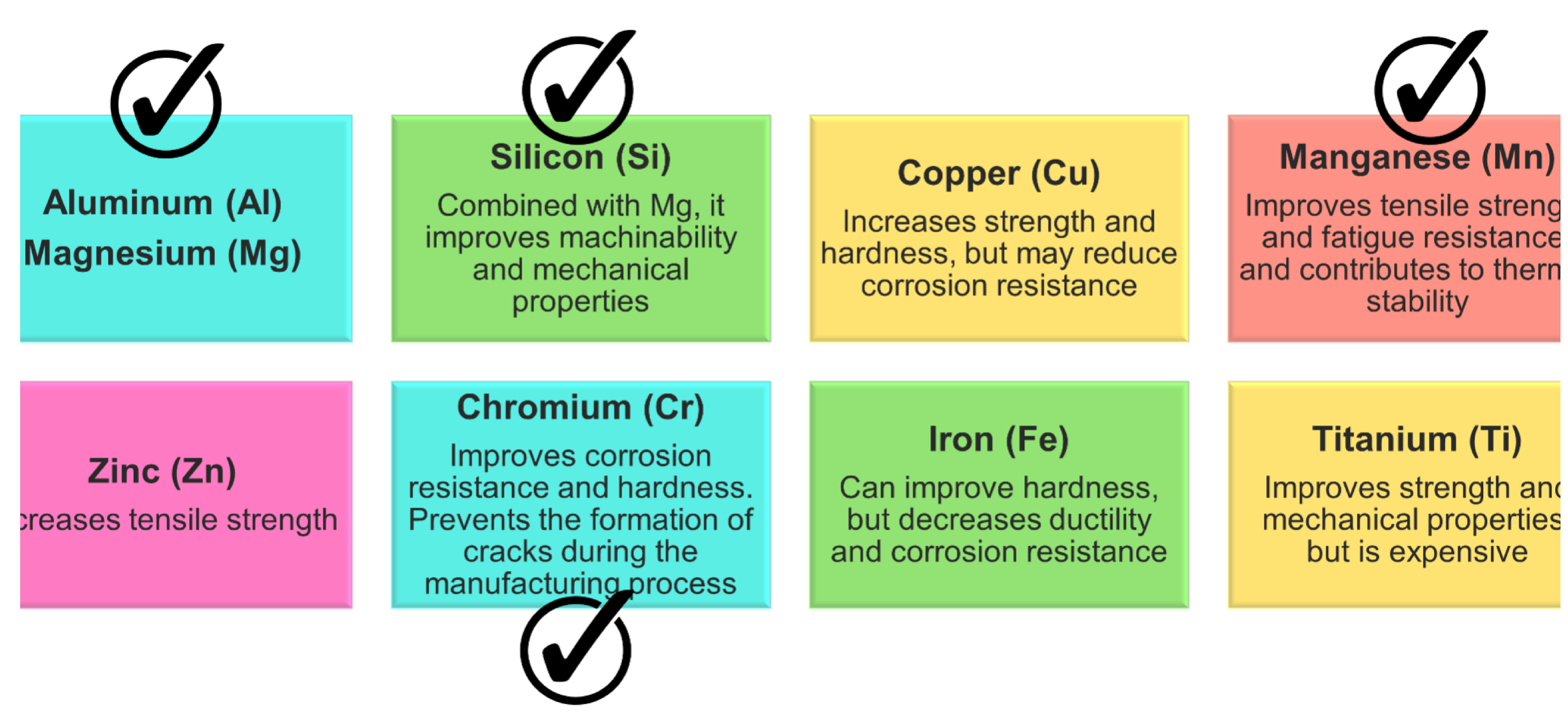

Figure 6: High Entropy Alloy composition selection process

STAGES

Preparation Phase

- Meetings with FACH and CCHEN
- Fabrication of HEA's coated aluminum alloys
- Fabrication of other equipments

Testing Phase

- Do pre and post exposure analysis (superficial XPS, SEM, EDS, microstructural XRD and chemical OCP, EIS, LSV)
- Exposure of samples

CONCLUSIONS

- Materials constituent to the satellites are subjected to extreme conditions.
- It is imperative to innovate in materials that safeguard their structure.
- High entropy alloys are emerging as a promising alternative in this regard.

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