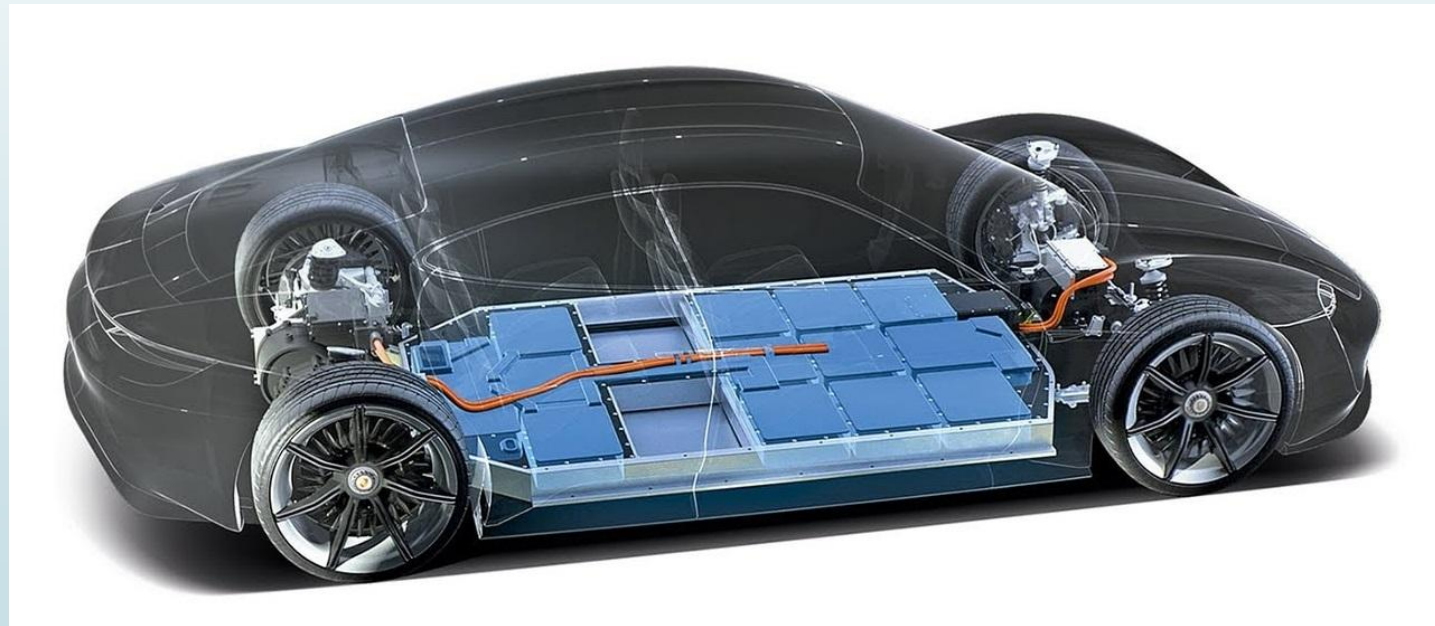


# CASING FOR ELECTRIC VEHICLE BATTERY

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A Material Science Perspective



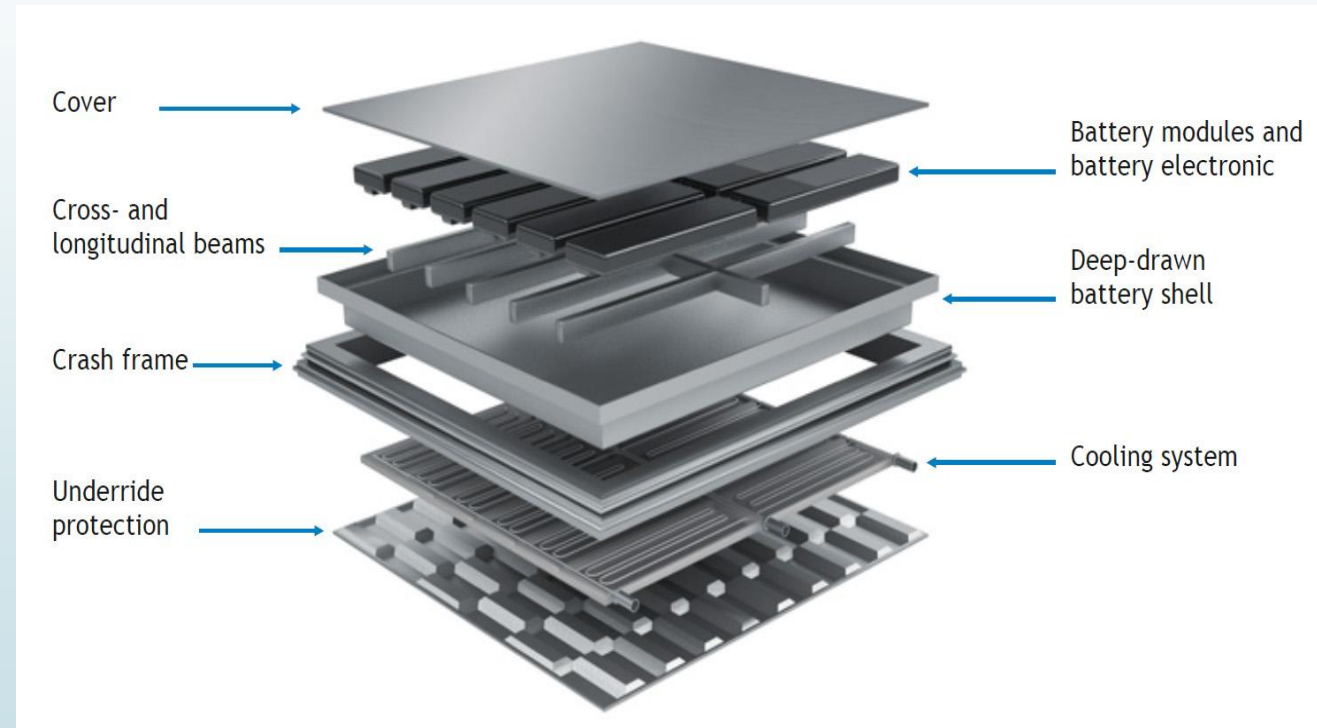
The future of transportation is electric. It's a cleaner, quieter, and more efficient way to get around.

# INTRODUCTION

Casing of an EV battery is a crucial component which protects the battery cells.

Functions of EV battery Casing:-

- ❖ Thermal management
- ❖ Structural Integrity
- ❖ Electrical Insulation
- ❖ Protection from external factors( ex :-impacts, vibration ,corrosion etc.)



# Material Properties Required

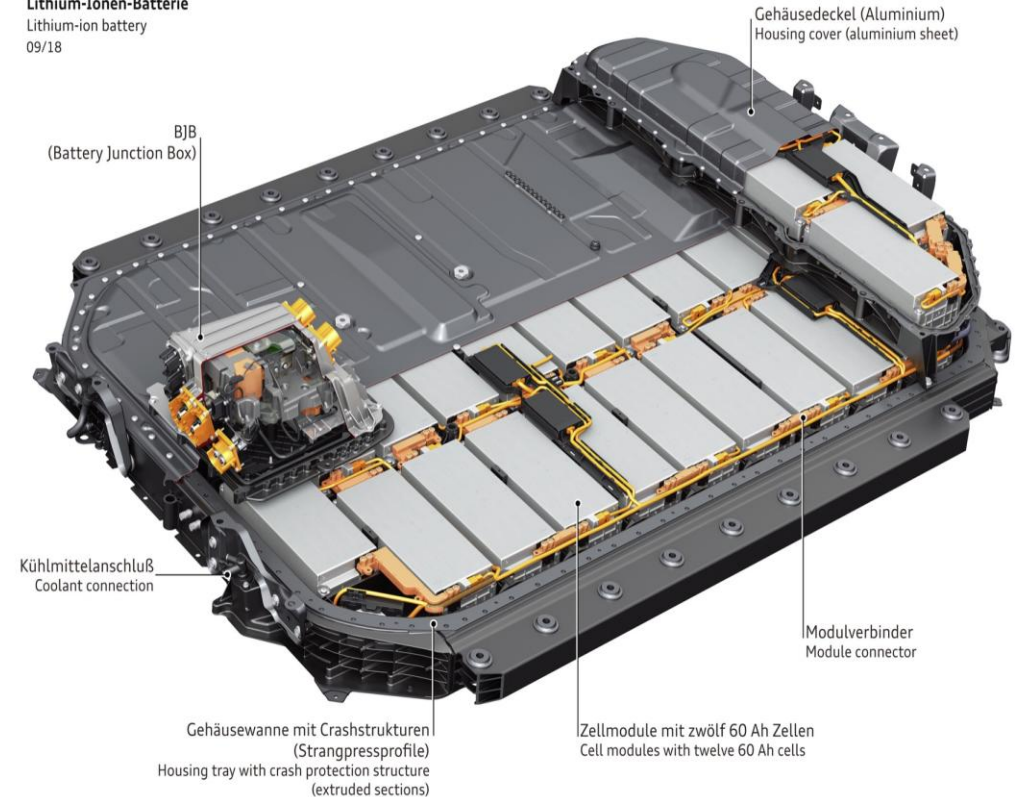
- ❖ Light Weight
- ❖ Stiffness (provides Structural Integrity)
- ❖ Fire protection
- ❖ Thermal management
- ❖ Crash-protection
- ❖ Resistance to corrosion
- ❖ Ease of manufacturing & economic feasibility

## Reference:-

<https://www.ijraset.com/best-journal/comparative-material-selection-of-battery-pack-casing-for-an-electric-vehicle>

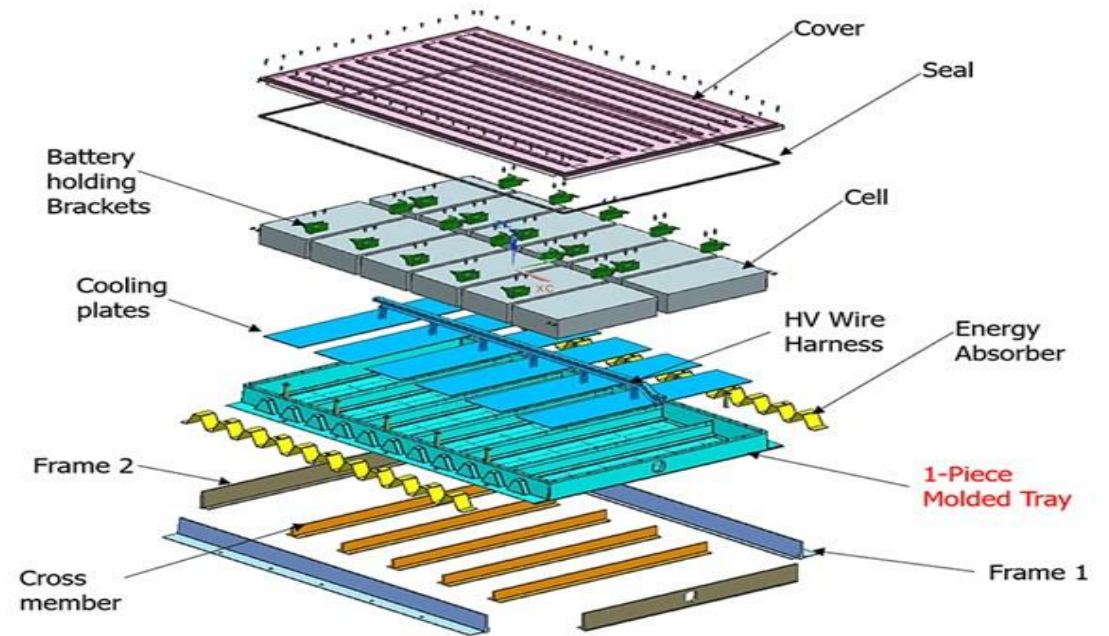
## Audi e-tron

Lithium-Ionen-Batterie  
Lithium-ion battery  
09/18



# Different Materials Used

- ❖ Steel and Aluminium alloys
- ❖ Titanium
- ❖ Composites(CFRP,GFRP etc.)
- ❖ Thermoplastic engineering polymers(ex:-polypropylene (PP) and polyamide (PA) )



## References:-

[https://msecore.northwestern.edu/390/2023/group4\\_Battery\\_Casing.pdf](https://msecore.northwestern.edu/390/2023/group4_Battery_Casing.pdf)

<https://www.ijraset.com/best-journal/comparative-material-selection-of-battery-pack-casing-for-an-electric-vehicle>

[Electromagnetic Interference EMI Shielding and Thermal Management of Sandwich-Structured Carbon Fiber](#)



# Best Materials

- ❖ **Aluminum:** Lightweight, corrosion-resistant, good conductor of heat, & recyclable  
Ex:-Al 7750(7000 series), Al A390(18 wt.% Si, 4.5 wt.% Cu, 0.55 wt.% Mg, rest Al) etc.
- ❖ **Steel:** Provides high strength and durability, especially in crash scenarios. But it is heavier.  
Ex:-High strength Steel(HSS) etc.
- ❖ **Composites:** superior strength and lightweight characteristics, corrosion resistant and design flexibility.  
Ex:-CFRC, CFRC + Gr/Cu

## Reference:-

<https://www.sciencedirect.com/science/article/pii/S1364032116002483>

Materials used for battery pack casing in various commercial cars.

Vehicle	Material used for battery case
Tesla Roadster	Aluminium
Honda Fit EV	Steel
Chevrolet Volt	Steel
Chevrolet Spark EV	Composite
BMW i3	Aluminium

Property	Aluminium (Al A390)	Steel	CFRC
Density(g/cm <sup>3</sup> )	2.72	7.85	0.92
Young's Modulus(Gpa)	~70	190-210	5.8-6.5
Tensile Strength(Mpa)	450-520	500-1200	295±32.2
Thermal coefficient (/°C)	23× 10 <sup>-6</sup>	12× 10 <sup>-6</sup>	6.5× 10 <sup>-6</sup> to 3.5× 10 <sup>-6</sup>
Corrosive	No	Yes	No
Fire-resistant	Yes	Yes	Yes
Ease of manufacturing	Easy to manufacture and process Cost-effective	Req additional steps to process than Aluminium. Cost-effective than CFRC	Complex to manufacture  Most expensive

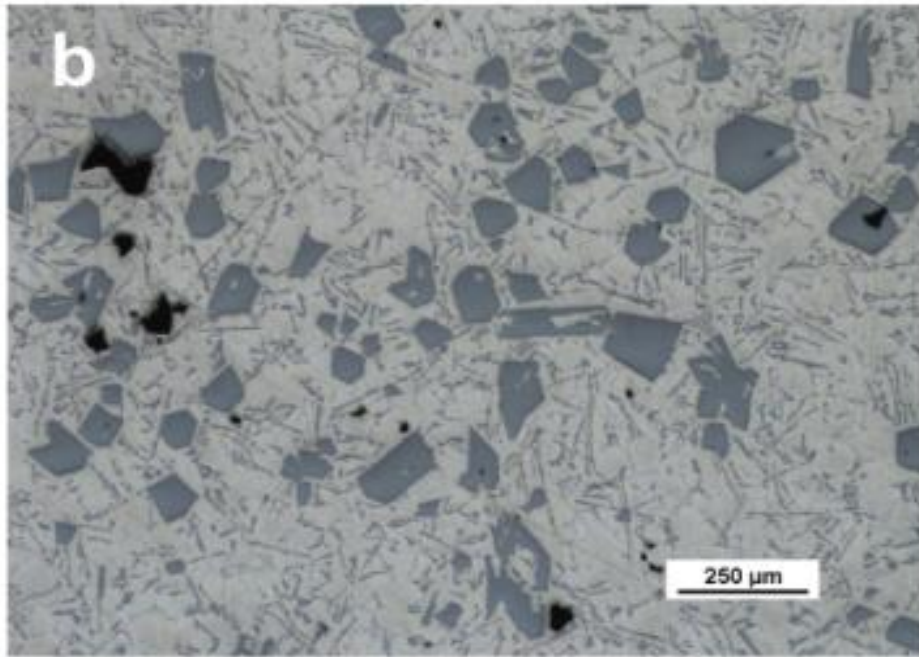
### References:

[Electromagnetic Interference EMI Shielding and Thermal Management of Sandwich-Structured Carbon Fiber  
https://msecore.northwestern.edu/390/2023/group4\\_Battery\\_Casing.pdf](https://msecore.northwestern.edu/390/2023/group4_Battery_Casing.pdf)

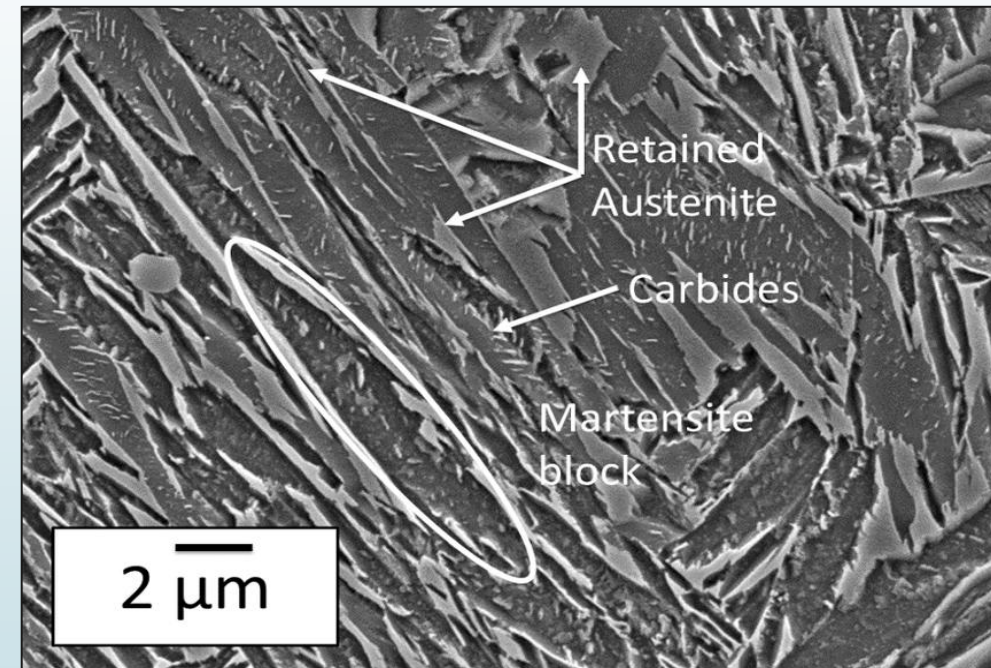
# Microstructure & it's relationship with mechanical properties

Aluminium Al A390(18 wt.% Si, 4.5 wt.% Cu, 0.55 wt.% Mg, rest Al)

18 wt% Si



Steel

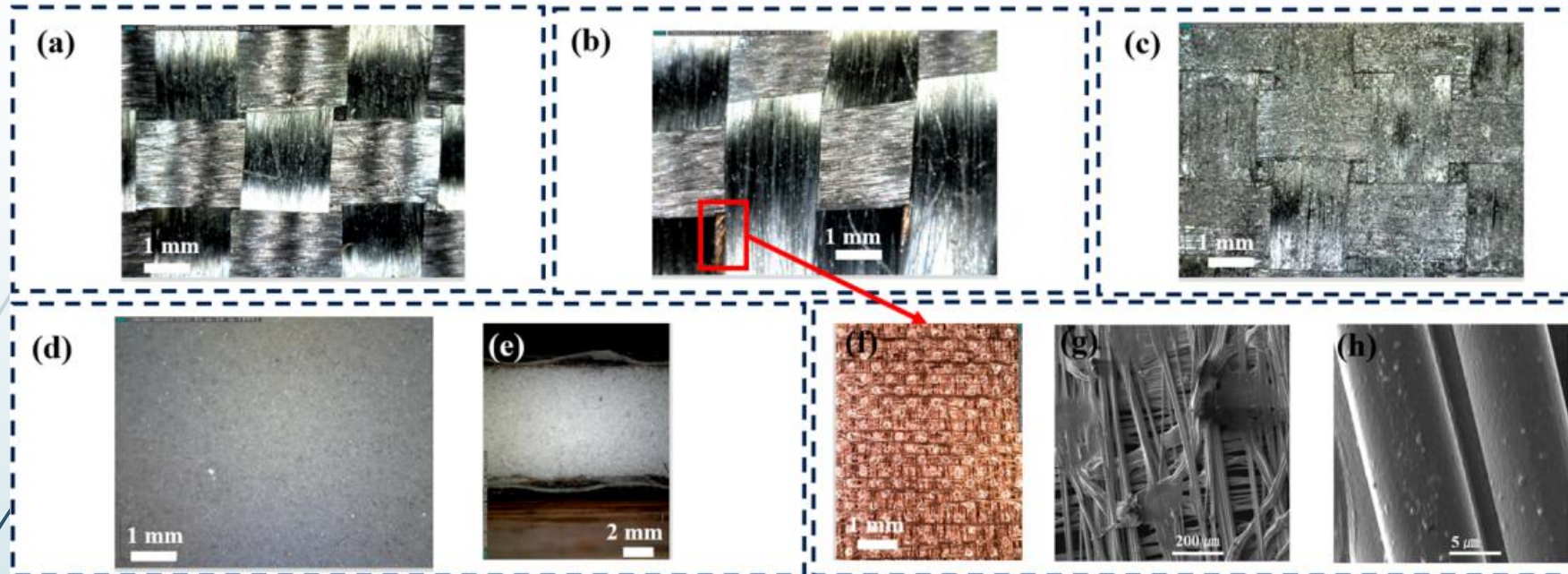


## References:

[https://www.researchgate.net/figure/Scanning-electron-microscopy-SEM-micrograph-of-the-studied-steel-after-Q-P-heat\\_fig1\\_326006520](https://www.researchgate.net/figure/Scanning-electron-microscopy-SEM-micrograph-of-the-studied-steel-after-Q-P-heat_fig1_326006520)

[https://msecore.northwestern.edu/390/2023/group4\\_Battery\\_Casing.pdf](https://msecore.northwestern.edu/390/2023/group4_Battery_Casing.pdf)

## CFRC(Carbon Fiber Reinforced Composite)



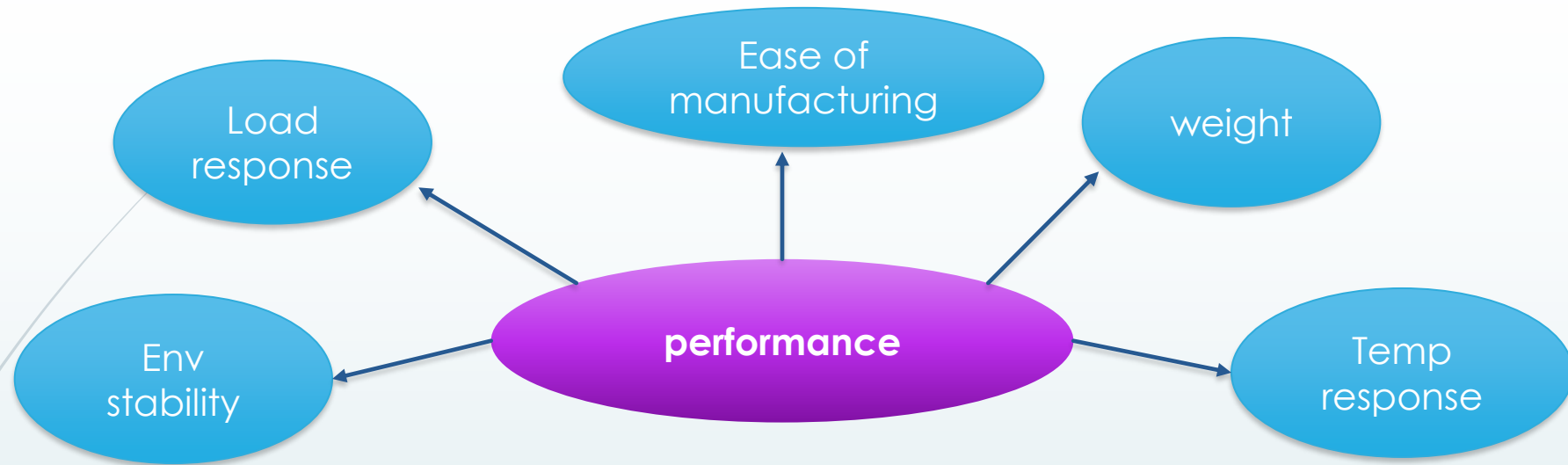
- Microstructure can be refined such that a desired material can be made useful for our application.
- By methods like quenching ,precipitate hardening, tempering properties of the material is modified.

### References:

[Electromagnetic Interference EMI Shielding and Thermal Management of Sandwich-Structured Carbon Fiber](#)



# Selection of material for EV battery casing



## **Aluminium:**

- Light weight(due to low density),provides structural integrity for the EV because of good stiffness(it's a metal)
- It has resistance to corrosion
- In Al A390 %Si effects hardness and toughness of aluminium which are major factors in stability of EV in the event of crash and any stresses developed due to loading.

## **Reference:**

<https://www.mdpi.com/2624-8921/5/2/28>

## **Steel:**

- High strength and durability provides stability to the EV.
- It has very good impact resistance.
- Prevent over heating and maintain battery optimal performance.
- Ease in manufacturing and it is very cost effective.

## **CFRC:**

- High strength to weight ratio which makes overall weight of EV less and provides stability to the structure.
- It has good impact and corrosion resistance.
- It offers greater design flexibility compared to metals

## **References:**

[https://msecore.northwestern.edu/390/2023/group4\\_Battery\\_Casing.pdf](https://msecore.northwestern.edu/390/2023/group4_Battery_Casing.pdf)

# THANK YOU