DEVELOPMENT OF DOMESTIC HYBRID COMPOSITES A356/SiCₚ/Grp WITH LARGE GRAPHITE PARTICLES

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A356 alloy: Al-Si alloy with 0.03 wt.% Sr

<table>
<thead>
<tr>
<th>Element</th>
<th>Si</th>
<th>Mg</th>
<th>Cu</th>
<th>Fe</th>
<th>Zn</th>
<th>Al</th>
</tr>
</thead>
<tbody>
<tr>
<td>wt.%</td>
<td>7.20</td>
<td>0.29</td>
<td>0.02</td>
<td>0.18</td>
<td>0.01</td>
<td>balance</td>
</tr>
</tbody>
</table>

Properties: excellent mechanical characteristics, high wear resistance, very good corrosion resistance, very good casting and machining characteristics, good weldability

Application: High strength airframe and space frame structural parts, machine parts, truck chassis parts, high velocity blower and impeller

Improvement of characteristics:
- Heat treatment (T6 regime) → better mechanical properties
- Production of composites → increased wear resistance

AIM OF WORK: Preparation and characterization of hybrid composites A356/SiCₚ/Grp with large graphite particles

MAKING OF COMPOSITES

- Matrix: A356 alloy
- Secondary phases: SiC particles (24 μm), LARGE graphite particles (200 to 800 μm)
- Process: COMPOCasting → incorporation of secondary phases in the semi-solid melt of matrix alloy, with mechanical mixing
- Parameters: T = 610 °C, Vmix = 500 rpm, τul = 3, 4, 5 min
- Composites: conventional composite K1 (A356/10 wt.% SiCₚ), hybrid composites K2, K3, K4 (A356/10 wt.% SiCₚ + 1, 3, 5 wt.% Grp)
- Heat treatment (T4 regime): solution treatment at 540 °C for 1 h, followed by water quench (T = 20°C)

CHARACTERIZATION

MICROSTRUCTURE (SEM, XRD)

- Uniform distribution of SiC particles, without agglomerates and broken particles
- Mechanical bonding matrix/particle, continuous boundary surface (interface)
- No reaction: 3 SiC + 4 Al → Al₄C₃ + 3 Si

HARDNESS

Hardness of composites K1, K2 and K3 is higher than hardness of matrix (A356 alloy).
Hardness of composite K4 (5 wt.% Grp) is lower than hardness of matrix (A356 alloy) and hardness of composite K1, K2 and K3.

CONCLUSION

- Compocasting process is suitable for obtaining hybrid composites A356/SiCₚ/Grp
- Hybrid composites A356/SiCₚ/Grp are characterized with uniform distribution of secondary phases (SiC particles, large graphite particles) in the matrix (A356 alloy)
- Use of large graphite particles enabled a reliable control of compocasting process during infiltration of the particles and homogenous distribution of the particles in the matrix, without agglomerates (clusters)

**Application of composites with A356 matrix**

**Electric train ICE-2 brake disc (AlSi7Mg + 20 wt.% SiCₚ): lower weight, greater resistance to wear**

**A356/graphite, constructive parts**

**Schematic view of the apparatus for compocasting:**
- A. Processing part,
- B. Control and regulation of temperature.