DEVELOPMENT OF DOMESTIC HYBRID COMPOSITES A356/SiC_p/Gr_p WITH LARGE GRAPHITE PARTICLES

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

Element	Si	Mg	Cu	Fe	Zn	Al
wt.%	7,20	0,29	0,02	0,18	0,01	balance

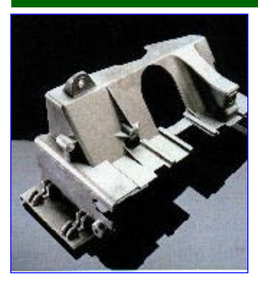
Properties: excellent mechanical characteristics, high wear resistance, very good corrosion resistance, very good casting and machining characteristics, good weldability

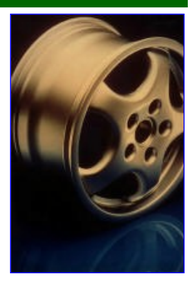
Application: High strength airframe and space frame structural parts, machine parts, truck chassis parts, high velocity blower and impeller

Improvement of characteristics:

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

Application of A356 alloy

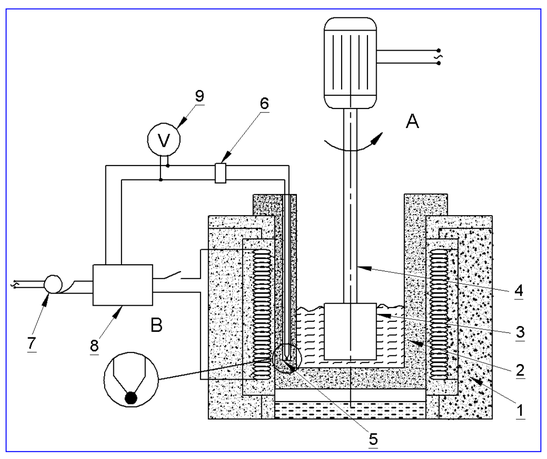




AIM OF WORK: ***Preparation and characterization of hybrid composites A356/SiC_p/Gr_p with large graphite particles***

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, v_{mix} = 500 rpm, t_{inf} = 3, 4, 5 min (1, 3, 5 mas.% **large graphite particles**)
- **Composites:** conventional composite **K1 (A356/10 wt.% SiC_p)** hybrid composites **K2, K3, K4 (A356/10 wt.% SiC_p + 1, 3, 5 wt.% Gr_p)**
- **Heat treatment (T4 regime):** solution treatment at 540 °C for 1 h, followed by water quench (T = 20°C)

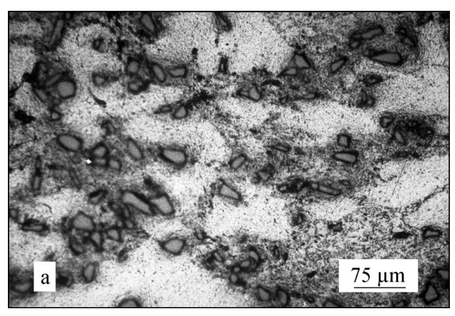


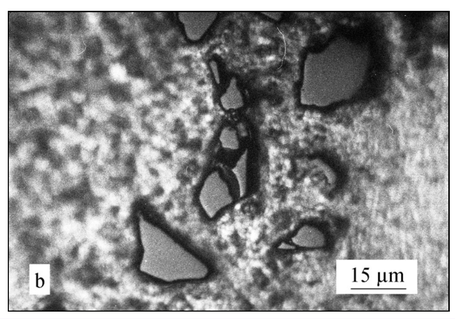
Schematic view of the apparatus for compocasting:
A. Processing part,
B. Control and regulation of temperature.

CHARACTERIZATION

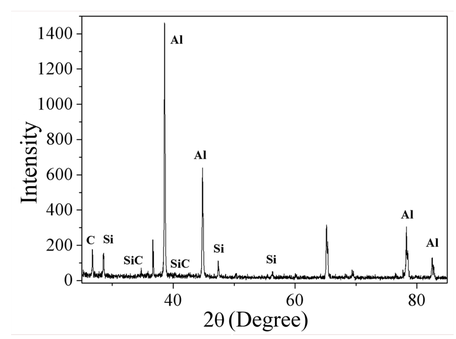
MICROSTRUCTURE (SEM, XRD)

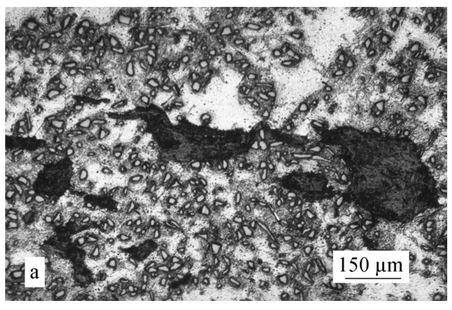
- **Uniform distribution of SiC particles, without agglomerates and broken particles**
- **Mechanical bonding matrix/particle, continuous boundary surface (interface)**
- **No reaction: 3 SiC + 4 Al → Al_4C_3 + 3 Si**

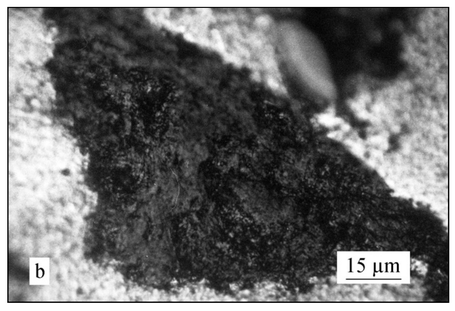




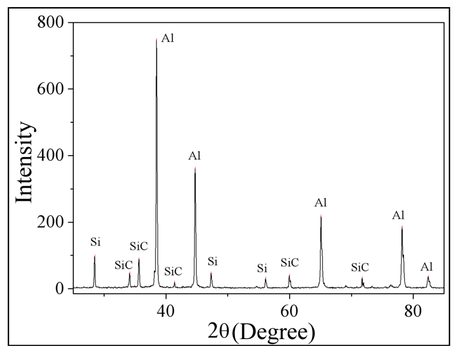
K1: A356/10 wt.% SiC (SEM)





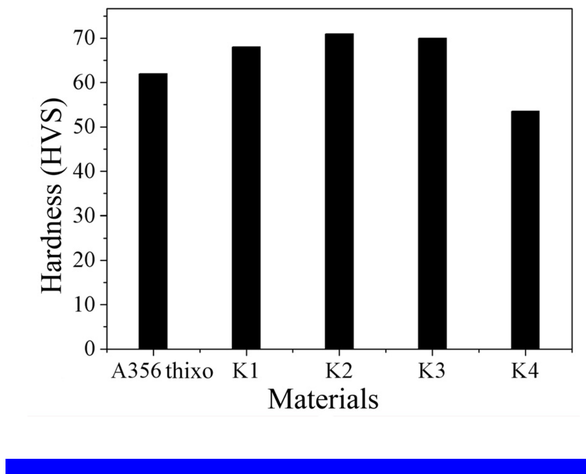


K3: A356/10 wt.% SiC/3 wt.% Gr (SEM)



- **Uniform distribution of SiC particles and large graphite particles, without agglomerates and broken graphite particles**
- **Mechanical bonding matrix/particle, continuous boundary surface (interface)**
- **No reaction: 4 Al + 3 C → Al_4C_3**

HARDNESS



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

Application of composites with A356 matrix


Electric train ICE–2, brake disc (AlSi7Mg + 20 WT.% SiC_p): lower weight, greater resistance to wear

A356/graphite, constructive parts

CONCLUSION

- **Compocasting process is suitable for obtaining hybrid composites A356/SiC_p/Gr_p**
- **Hybrid composites A356/SiC_p/Gr_p 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)**