Infuence of Pouring Temperature on Stir Casting of Al/SiC/Mg/Cu Composite

Tamilanban Thangaraju (ttamilraju@gmail.com)
St.Joseph College of Engineering https://orcid.org/0000-0001-5700-0771
Ravikumar T S
St.Joseph College of Engineering
Kanthasamy S
St.Joseph College of Engineering

Research Article

Keywords: AlMMC, SiC, pouring temperature, microstructure, stir casting

Posted Date: March 17th, 2021

DOI: https://doi.org/10.21203/rs.3.rs-314471/v1

Noname manuscript No.
(will be inserted by the editor)

Influence of Pouring Temperature on Stir Casting of Al/SiC/Mg/Cu Composite

T Tamilanban · T S Ravikumar

Received: date / Accepted: date

Abstract The effect of pouring temperature while preparing Aluminium SiC metal matrix composites, with additional benefits of magnesium and copper through stir casting technique were investigated. The composites were fabricated by mixing 12 wt% of SiC reinforcements, 4 wt% magnesium and 2 wt% copper into 6061 aluminium alloy melt at different pouring temperatures (630 °C, 670 °C and 710°C). The addition of magnesium will enhance the wettability of the SiC particles with Al matrix. The inclusion of copper has considerable improvement in strength and hardness of the composite. The microstructure and mechanical properties (tensile strength and hardness) of the Al MMC are evaluated with the corresponding processing parameter, specifically pouring temperature of the cast composite. The metallurgical characterization utilizing optical and scanning electron microscope were observed for the prepared composites. The coarse microstructure and homogenous distribution of SiC particles were appeared within dendrite structures of the composites. The SiC particles has effectively distributed, and higher tensile strength and maximum hardness have occurred in composite at pouring temperature of 670°C as compared to other composites. The mechanical properties were lower in composites prepared using lesser pouring temperature (630°C) and significantly decreased for higher pouring temperature (710°C) of the composites.

Keywords AlMMC · SiC · pouring temperature · microstructure · stir casting

T Tamilanban
Department of Mechanical Engineering,
Hindustan Institute of Technology and Science,
Chennai 603103, India
E-mail: ttamilraju@gmail.com

T S Ravikumar
Department of Mechanical Engineering,
Hindustan Institute of Technology and Science,
Chennai 603103, India
E-mail: bravikumar@hindustanuniv.ac.in

1 Introduction

Metal matrix composites (MMC) have more beneficial mechanical and tribological properties, and advantageous than compared to monolithic materials. Aluminium based MMC have significant strength, hardness and tribological properties when compared to its matrix materials. However, the Aluminium Metal Matrix Composites (Al MMC) are poor in ductility which limits its applications. To enhance its ductility, other alloying elements can be added and fabrication procedure parameters can be investigated to improve its performance. Al MMC's are generally prepared by casting, with ceramic materials reinforced through blending in molten alloy matrix by dispersion method [1]. Stir casting is a mechanical process to prepare composites with motorized stirring imposed to form vortex which mixes reinforcements into the molten matrix. Among the different processing procedures available for MMC, stir casting is the most economical and beneficial technique [2]. Currently, Al SiC composites has been successfully used in many automobile, electronics and aerospace components based on its advantages related to mechanical properties [2–5]. A broad selection of ceramic reinforcements such as SiC, B4C, ZrO2, Al2O3, TiC and graphite have been assisted into aluminium composites. The composites face few crucial problems such as, poor wettability of ceramic particles with matrix and higher porosity defects. Low wettability decreases the interface bonding quality among matrix and SiC particles. Higher porosity levels were found in the composite with increasing inclusion of ceramic particles [6]. The addition of SiC particles to aluminium has gained much attention among researchers, because of great bonding nature and admirable physical properties, which makes it a desirable reinforcing material [5]. For producing Al MMC certain considerations to be made, such as no negative reaction formed between the matrix and reinforcement particles, lesser porosity in the cast, uniform distribution of reinforcement and good wettability [2]. These considerations greatly affect the properties of the composite. The Magnesium (Mg) and Copper (Cu) alloying additions creates impermanent layer between particle and matrix. These layer causes low wetting point reducing the surface tension of the liquid and surrounds the particles with a phase combined with both matrix and particle. The wettability between the matrix and SiC particles can be increased with the addition of Mg element. The hardness and wear resistance of the composites increases considerably, with the addition of copper [4]. In composites prepared at 750^o C pouring temperature, reinforcement distribution is better than other composites, which decides the final property of the composite. The SiC particle reacts with aluminium to form brittle reaction at the matrix-particle interface [6]. The gradual increase in addition of SiC/ceramic particles as reinforcement, reduces the ductile capacity of the aluminium alloys [5,7]. Previous researchers have reinforced the SiC ceramic particles with different types of Al alloys and evaluated based on its properties. The SiC particles were reinforced in Al-Si-Fe alloy and analysis based on its mechanical properties showed higher tensile strength and hardness values but porosity defects levels were also increased [8]. The addition of SiC particles were varied with different levels while preparing Al composites and reported high mechanical properties were achieved with 20% SiC inclusion [9]. It was also noticed that Al 5%SiC developed better tensile strength compared to Al 10%SiC. The average size of SiC particles added in Al composites was varied and results of bending strength was proportionally decreasing with increase in average particle size [10]. The composites can be prepared by including 30 wt%SiC, only along with incorporation of graphene nano platelets (up to 0.5 wt%), which will increase the hardness and compressive strength [11]. With larger reinforcement dimensions and higher volume proportion, the wear resistance of the composites has improved [12,13]. Slower stirring speed and duration will lead to SiC particle clustering in few locations and some places without SiC particles. Increasing the speed and time will create uniform distribution of particles. Hardness of the composites was influenced by the stirring speed and time of stir casting [14]. The ductility of the composites can be improved by using blunted SiC particles to reinforce in the matrix alloy [15]. SiC particles with various quantity addition (5-40 wt.%) and different mesh size (150 and 600μm) were added in Al 6061 alloy to prepare composites which had significant improvement in wear performance [16]. Al 6061 alloy reinforced with 5%SiC exhibited better wear performance and enhanced hardness values in comparison with the base alloy [17]. Al 6061-SiC (2-6 wt.%) MMC was prepared using liquid metallurgy process (stir casting). The SiC reinforcement distribution was homogeneous in the matrix and the mechanical properties of the composites were noticed to surge as the particulate content was increased [18]. Mechanical behaviour of nano SiC reinforced Al alloy was researched. Hardness and tensile strength values were enhanced by nearly 66% and 20% respectively, with inclusion of nano SiC particles. It was noted that adding above 2% nano SiC with aluminium composites was not feasibly effective for incorporation [19]. The present work was performed to evaluate the impact of pouring temperature conditions on mechanical and microanalysis while preparing MMC with 6061 Al, 4 wt.% Mg, 2 wt.% Cu and 12% micron level SiC particles through conventional stir casting technique. The aim is to increase the quality of the composites by reducing the defects through varying the pouring temperature on composites produced from the stir casting method. Hence, mechanical properties of the composites were investigated in relation to the microstructure and its defects. The mechanical characterization of aluminium composites was performed to find tensile strength, percentage elongation and micro-hardness. Further, the distribution and bonding strength of SiC particles were investigated using optical and scanning electron microscope along with elemental analysis using EDX technique.

2 Experimental procedure

The 6061 aluminium alloy is used to prepare the Aluminium MMC and its chemical composition are 0.93 wt% Mg, 0.63 wt.% Si, 0.52 wt.% Mn, 0.2 wt.% Cu, 0.17 wt.% Fe and remainder Al. Silicon carbide (SiC) are chosen as primary reinforcement particle as it forms good chemical bonding with aluminium matrix and also has admirable physical properties. Also the pure magnesium powder and copper powder are added while preparing the composite to increase the strengthening mechanism. The aluminium 12% SiC metal matrix composite with 4% Mg and 2% Cu quantity are prepared through stir casting method using mechanical stirrer blade. Initially to fabricate composite, aluminium alloy

6061 plates are melted at 750°C using electric furnace. Following, 120 gm of SiC with average size of 30μm are added gradually in preheated condition of 350°C. Further 40 gm of Mg and 20 gm of Cu are added in exact quantity into the molten metal. The stir casting parameters were 700 RPM stirring speed and 12 minutes stirring time while adding the reinforcement gradually [20]. Finally the Al MMC in molten condition is poured into the preheated mould maintained at temperature of 350° C. The whole melt is poured at 630°C in to the permanent mould of dimensions (120 mm L x 120 mm W x 25 mm T) and allowed to be solidified and then removed. Likewise the above process was followed for the other two composites processed at pouring temperatures of 670°C and 710°C. Three different composites samples are prepared in various conditions of pouring temperatures at 630°C, 670°C and 710°C. Temperature of the furnace is precisely measured and controlled with thermocouples and PID controllers respectively. This purpose was to produce good quality composites. Tensile samples of ASTM standard E8M and hardness test samples of ASTM-E92-82 are prepared accordingly from the solidified cast Al MMC using wire cut EDM process. Three tensile samples of standard size were tested for each composite in Universal Testing Machine and average values were calculated. Wilson wolpert Vickers hardness tester were used to measure hardness values with pyramidal diamond intender for 15 seconds dwell time at 0.5Kg loading condition in three different locations for each composite and average values were specified. Keller's reagent etchant was applied for preparing OM and SEM samples after polishing and grinding for micro structural analysis.

3 Result and Discussion

3.1 Microstructure studies

Fig. 1 (a-c) shows the macrostructures of the cast composites prepared at three different pouring temperatures. Macro analysis in this study is to compare the grain size and distribution of reinforcement of the composite. Macro images show the distribution of particles is more uniform in composites fabricated at 670°C pouring temperature. The clusters of SiC reinforcements are visible in the composites prepared at other pouring temperatures. Solidification behaviour from higher pouring temperature results in smaller grain size. Lower pouring temperature (630°C) has lead to rapid and improper solidification which results in formation of defects. Lower pouring temperatures are expected to form larger grain size, which could affect the mechanical properties as per Hall-Petch equation. Fig. 2 (a-c) shows narrow variations in fabricated Al SiC composites cast with varied pouring temperature of 630°C, 670°C and 710°C respectively. The influence of pouring temperature on microstructure is clearly visible with the size and formation of dendrites varied, depending on the pouring temperature. The aluminium cast grain had little variation in size by the different pouring temperature and the effect of addition of magnesium and copper has also varied [6]. Dendrites formed are continuous in lower pouring temperature and as the pouring temperature was increased, the size reduces between the dendrites and discontinuity also increases. The clustering of SiC particles are more in composites owing to its higher density and it hovers in lower region and middle region of molten metal mixture.

The uniform distribution of reinforcing particles was obvious, but few localized disorganization was formed in the composites [6]. The Fig. 2 (a) displays the clustering of particles visible along the Al matrix corresponding to lower pouring temperature 630°C. The accumulation of SiC reinforcement particles at few locations could be due to less fluidity formed by insufficient pouring temperature. The distribution of ceramic particles was improved for composite synthesized at 670°C pouring temperature than other composites. The quantity of entrapped SiC particles was significant in composite, showing that 670°C pouring temperature is contributing factor for enhanced ceramic particle inclusion in molten matrix. Fig. 2 (c) shows the microstructure of composite with pouring temperature 710°C, with considerable quantity of SiC particles incorporation. Formation of cast defects (solidification shrinkage) and improper incorporation of SiC particles has reduced the strength of this composite. Another important identification was gas pores are not visibly noticed in these images. Preheating SiC reinforcement particles, high stirring time and fluid flow has allowed entrapped gas to escape.

3.2 SEM

The SEM micrographs of the composites prepared with 670°C pouring temperatures are seen in Fig. 3, with distribution of SiC particles been significantly homogenous. SiC particles distribute homogeneously in composites with higher Mg content by increasing its wettability [21]. Further the SiC particles have more wettability with Al matrix, when prepared at optimum pouring temperatures [22]. In the 670°C pouring temperature composites, the particles are well settled into the matrix during solidification of the cast composites. No major defects such as voids, pits or solidification shrinkage were observed from the composites prepared at 670°C

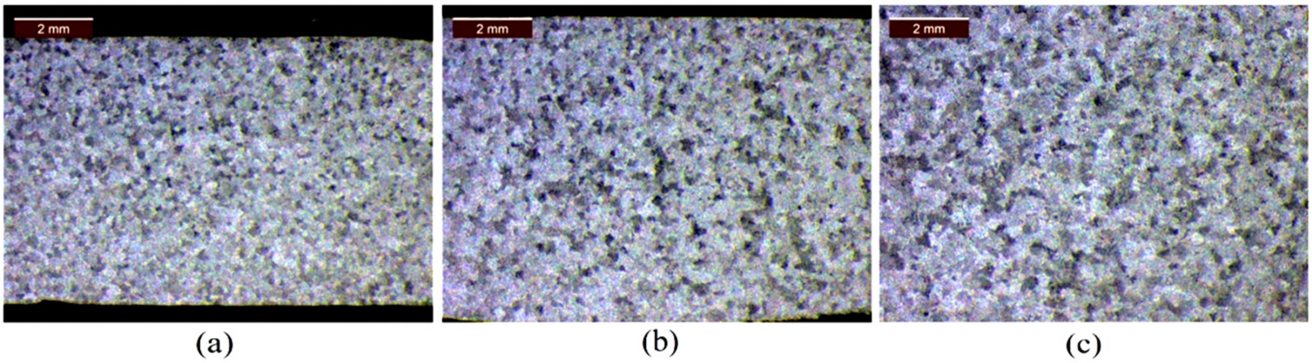

Fig. 1 Macro images of composites prepared at pouring temperatures a) 630 °C b) 670 °C and c) 710 °C

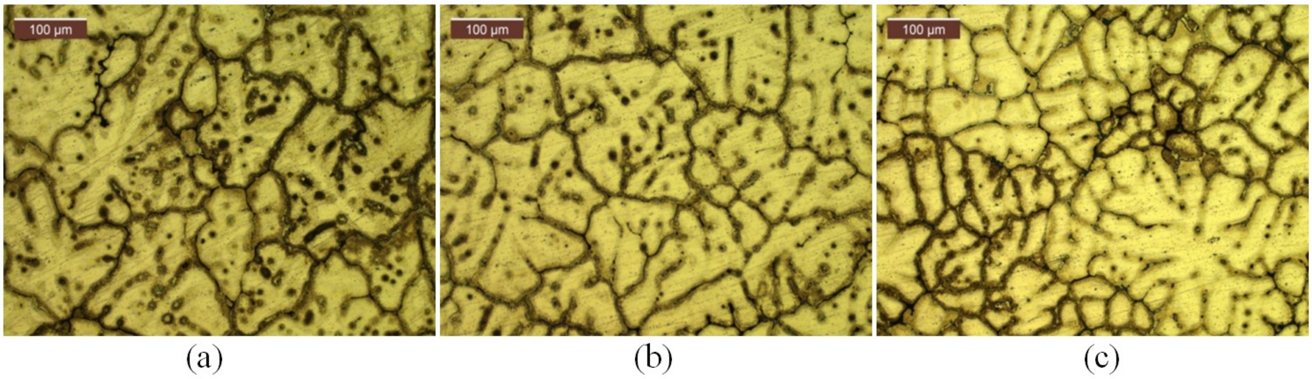

Fig. 2 Optical Microstructure images of stir casted composites with three different pouring temperature a) 630 °C b) 670 °C and c) 710 °C) 710 °C

pouring temperature. The Al4C3 compound phase formation must have varied intensively based on pouring temperatures. Increasing pouring temperature can form more such brittle compound phases [6].

Line energy dispersive X-ray spectroscopy (EDX) microanalysis was used to evaluate the chemical characterization around the ceramic particle in composite. Fig. 3 shows the SEM elemental line scan data of composite in order to confirm the presence of SiC particles. Spectrum shows expected major elements such as Al, Mg, Si, C and C. The signal of Al is at maximum outside the particle boundary and it decreases sharply at the particles location approaches. The silicon (Si) signal significantly increases at the SiC particles region. Mg was present at the SiC/matrix interface and in the matrix region of aluminium with same intensity, revealing the high quality of composite fabrication [2,6]. Fig. 4 illustrates the SEM and EDX mapping images of the composite prepared at 670°C pouring temperature. From the SEM-EDX mapping analysis, it was seen that the SiC particles are located in the matrix, and confirms the existence of SiC particles addition in the composite. As given in Fig. 4 well distributed SiC particles (green region) can be observed in the matrix. Also Si region was clearly visible; Al matrix region was visible overall except the SiC particle region. Mg (blue region) was evenly distributed in the matrix as it provides solid solution strengthening effect. The Mg was also visible in the SiC particle region, which is because Mg addition helps to increase the wettablility between particle and matrix.

Premature solidification due to reduced fluidity by lower pouring temperature, leads to casting defects [6]. Fig. 5 (a) shows SiC particle surrounded with hollow matrix region, due to lesser fluidity, premature solidification and formation of thin brittle compound in the interface. Although the pouring temperature of 630°C was used for composite, no occurrence of strong bonding reaction was between the particle and matrix. The SiC particles are strongly attached with matrix and no detachment is noticed in composite poured at 670°C. The SiC particles eruption while polishing indicates poor bonding between reinforcement particles and matrix caused by higher pouring temperature (710°C). The SiC particle should not disengage from matrix, identically to produce a better bonding among matrix and particles. Faster solidification rate has created shrinkage gap between matrix and particle interface as seen in Fig. 5 (b). However, the particles have not detached from the matrix, which could be due to good interface

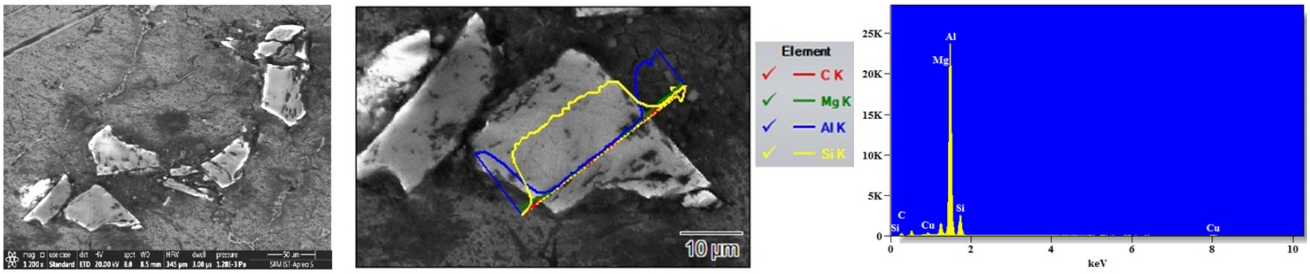

Fig. 3 SEM and Line energy dispersive Xray spectroscopy (EDX) data with Spectrum of the composite (670°C pouring temperature).

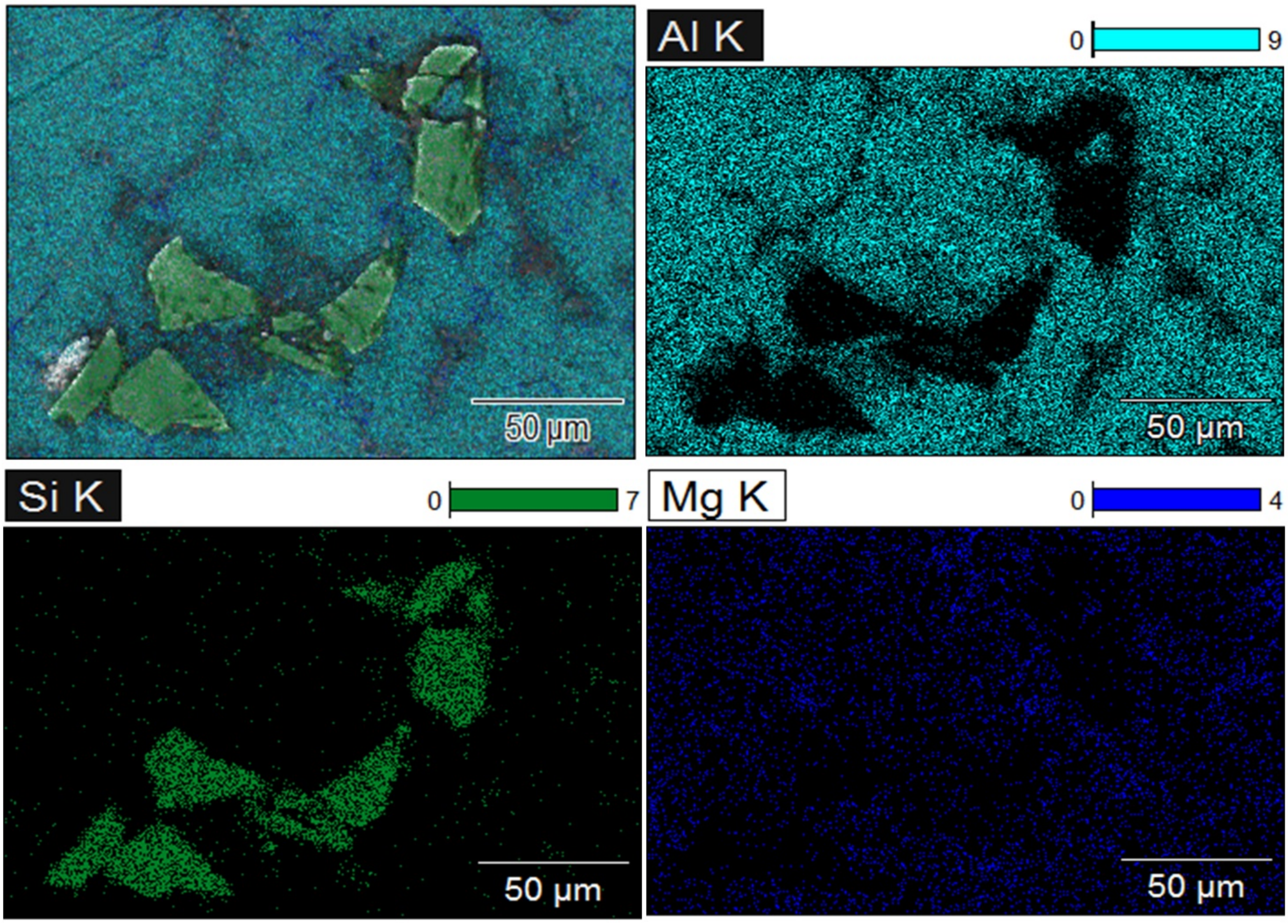

Fig. 4 SEM EDX data analysis on SiC particles region of the composites

bonding strength caused by the formation of thick brittle compound.

3.3 Mechanical properties

In general, SiC particles increase the stiffness value and capacity to share more load during deformation along with Al matrix to increase the tensile property. Minor difference in dendrite structure will not result with unfavourable outcome in tensile properties [6]. Mechanical testing was done to assess the impact of the pouring temperatures in the strength of composites. Fig. 6 shows the results of mechanical properties of the composites. As it can be seen 670°C poured composite produced higher result comparatively. When the cast metal was poured at 670°C, distribution and presence of reinforcement particles was observed to be better homogeneous when compared to other composites poured at different temperatures, hence higher mechanical properties were attained. The maximum tensile strength of Al SiC composites was 208 MPa for the composite pre-

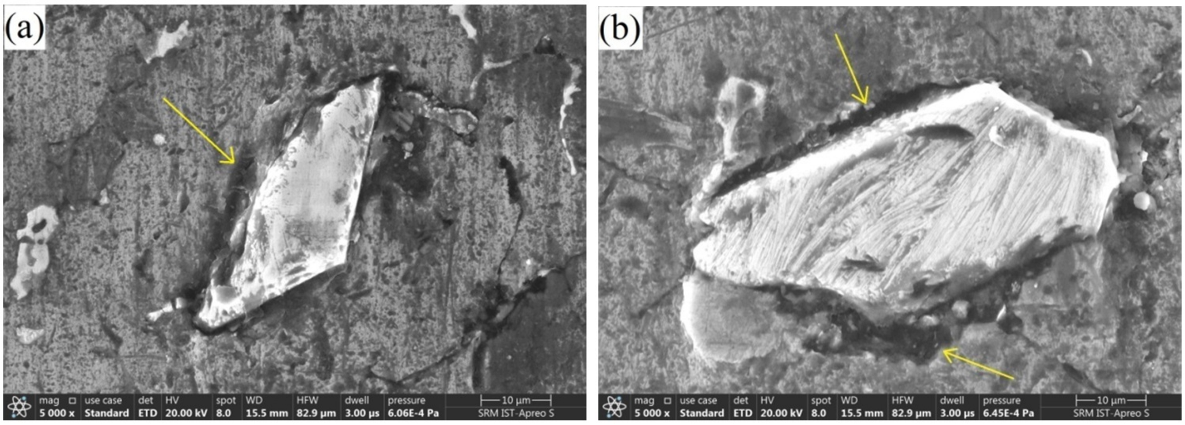

Fig. 5 SEM images of composites prepared at pouring temperatures (a) 630°C and (b) 710°C

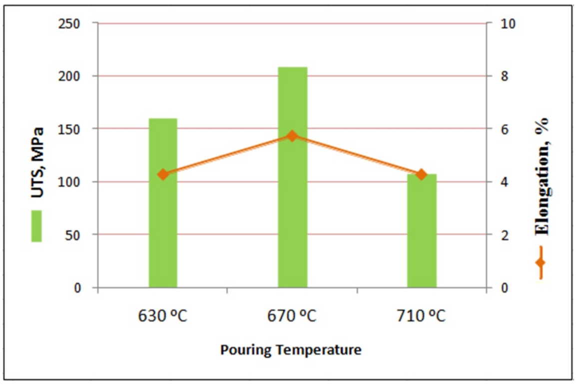

Fig. 6 Mechanical properties of the composites

pared at 670°C pouring temperature. The SiC particles inclusion along with Mg and Cu alloying indicates considerable improvement in the composites. Premature solidification, less particles incorporation, shrinkage defects and clustering of particles due to reduced fluidity can be related to reduction in tensile properties of the composite poured at 630°C. In case of 710°C pouring temperature, formation of intense brittle phase, shrinkage defects and high internal stress has played considerable role for declining the tensile properties of the composite. The increase of pouring temperature results in better bonding of SiC particles, but beyond certain temperature, Al4C3 compound formation is higher. These phases can affect the mechanical properties of the composites. But still there is no significant information about Al4C3 could affect the strength of composite [2].

The percentage elongation of the composites was observed with reduction as a consequence of reinforcement particles resisting the flowability of matrix. Ductility relies on quantity of SiC particle reinforced in the composite material and particle bonding strength. The decrement of elongation is high in composites prepared at pouring temperatures 630°C and 710°C. Further, the development of shrinkage defects is crucial aspects reducing the ductile values of the composite. The composite prepared with 670°C pouring temperature has produced better elongation values. Furthermore, the ductility of the composites was also reduced by the pointed edges of the SiC particles reinforced in the matrix alloy. SiC particles with pointed shape have serious stress concentration, causing deformation near the sharp corners of the particles elongated along the tensile direction [15]. Table 1 shows the result of Vickers micro-hardness tests results taken for the composites. In general, the hardness quality improves, as the amount of SiC particles added are increased within limits. The hardness improves due to the deformation resisted by the high solidness of the reinforced SiC particles in comparison with softer aluminium matrix [5]. But the difference in hardness by varying pouring temperatures was identified, which is determined by solidification behaviour leading to variation in incorporation of SiC particles in the composites. The hardness of the composites has further increased with the addition of copper and magnesium alloying elements. The maximum enhancement of hardness was recognized in Al SiC composite poured with temperature 670° C and the distribution of reinforcing particles were more homogenous to correlate with other pouring temperatures. It was due to the reason that required fluidity was achieved by this pouring temperature, leading to good quality of composite. The strong interface bonding between Al and reinforcement has penetrate the load transfer to SiC particles, so the resistance to penetration increased in composite made with pouring temperature 670°C. But at certain pouring temperature, the hardness of the composite increases and reduces again as the temperature is increased. The hardness reduction was due to clustering and uneven distribution of SiC particles.

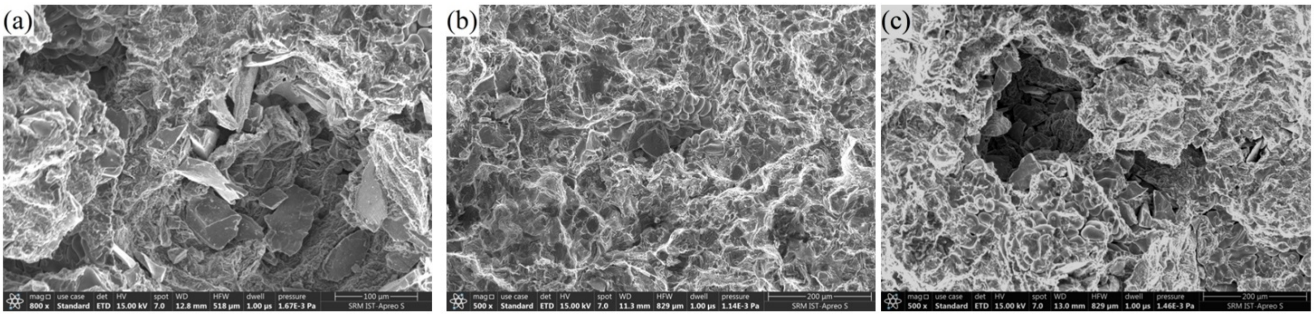

Fig. 7 Fractography images of tensile failure samples of the composites prepared at pouring temperatures a) 630 °C b) 670 °C and c) 710°C

Location	Pouring temperatures		
	630°C	**670°C**	**710°C**
1	99.4	98.5	87.3
2	94.1	106.2	86.2
3	95.2	105.2	87.6
Average	**96.2**	**103.3**	**87.03**

Table 1 Hardness values of composites

3.4 Fractographic studies

Fig. 7 (a-c) shows the fractographic images of tensile samples with brittle nature in common with all three composites. No dimples were visible in the fracture location, evident for brittle nature of fracture. The composite prepared with 670° C pouring temperature shows particle fracture mode with strong bonding. The matrix deformation has appeared first and followed by Al SiC interface location fracture. The SiC particles were evenly distributed in composite poured at 670°C temperature, hence fracture was uniform, and no uneven deformation was visible in Fig. 7 (b), like other composites where cluster fracture was seen. Fracture location shows clustering of particles in Fig. 7 (a) and it is the fracture initiation site. Clustering of particles can make the zone weaker as the bonding of particles with matrix will be weaker. Hence the tensile values of the composites have decreased. Cracks are visible in fractured composite prepared at higher pouring temperature, shown in Fig. 7 (c). When casting is poured at higher temperature, sudden reduction to room temperature leads to crack formation. In the case of poor interface bonding, the breaking of composite is initiated from particle before the deformation of Al matrix. The SiC particles are located in the fractograph clearly, which shows the fracture has initiated from the pointed corners of the particles, reducing the ductility of the composites. Sharp corners of the SiC particles tend to have lower bonding strength due to high stress concentration [15]. Hence the strength of the composites depends on bonding strength between the particles and matrix due to varying pouring temperatures.

4 Conclusion

The Al/SiC/Mg/Cu composites were successfully fabricated with three different pouring temperatures of molten metal, to study the microstructure and mechanical performance of the composites. The presence of SiC particles in the aluminium matrix were confirmed using SEM EDX analysis. At pouring temperature 670°C, the Al SiC composite with higher SiC particles incorporation were formed and good interfacial bonding with better distribution of particles guided to success of best tensile properties. At lower pouring temperature (630°C), cluster of reinforcement particles has been noticed, because of insufficient temperature for solidification and less fluidity, hence mechanical properties output were lower. When pouring temperature (710°C) were higher, brittle compound formation between interfaces were intensive and solidification shrinkage defects caused lower mechanical properties. It was found that hardness of the composites changes based on pouring temperature, as it was high when poured at 670°C temperature. Reduction in percentage elongation was seen in all composites prepared at various pouring temperatures because of resistance created by the hard ceramic reinforcement particles in flowability of Al matrix. The SEM fractographic studies on fracture surface of the tensile tested samples explained the brittle failure nature of composites. Finally it was concluded that pouring temperature, has adverse effect on microstructure and mechanical behaviour, making it as vital parameter for preparing Al/SiC/Mg/Cu composites.

References

1. Kaczmar JW, Pietrzak K, Wlosiński W. Production and application of metal matrix composite materials. Journal of Materials Processing Technology 2000; 106: 58–67.
2. Soltani S, Azari Khosroshahi R, Taherzadeh Mousavian R, Jiang ZY, Fadavi Boostani A, Brabazon D. Stir casting process for manufacture of Al–SiC composites. Rare Metals 2017; 36: 581–90.
3. Maurya NK, Maurya M, Srivastava AK, Dwivedi SP, Kumar A, Chauhan S. Investigation of mechanical properties of Al 6061/SiC composite prepared through stir casting technique. Materials Today: Proceedings. Vol25. Elsevier Ltd., 2019: 755–8.
4. Hassan AM, Alrashdan A, Hayajneh MT, Mayyas AT. Wear behavior of Al-Mg-Cu-based composites containing SiC particles. Tribology International 2009; 42: 1230–8.
5. Singh G, Sharma N, Goyal S, Sharma RC. Comparative Measurements of Physical and Mechanical Properties of AA6082 Based Composites Reinforced with B4C and SiC Particulates Produced via Stir Casting. Metals and Materials International2020; doi 10.1007/s12540-020-00666-0.
6. Rajaravi C, Gobalakrishnan B, Lakshminarayanan PR. Effect of pouring temperature on cast Al/SiCp and Al/TiB2 metal matrix composites. Journal of the Mechanical Behavior of Materials 2019; 28: 162–8.
7. Singh G, Goyal S. Microstructure and mechanical behavior of AA6082-T6/SiC/B4C-based aluminum hybrid composites. Particulate Science and Technology 2018; 36: 154–61.
8. Aigbodion VS, Hassan SB. Effects of silicon carbide reinforcement on microstructure and properties of cast Al-Si-Fe/SiC particulate composites. Materials Science and Engineering A 2007; 447: 355–60.
9. Rahman MH, Al Rashed HMM. Characterization of silicon carbide reinforced aluminum matrix Composites. Procedia Engineering 2014; 90: 103–9.
10. Tan Z, Chen Z, Fan G et al. Effect of particle size on the thermal and mechanical properties of aluminum composites reinforced with SiC and diamond. Materials and Design 2016; 90: 845–51.
11. Şenel MC, Gürbüz M, Koç E. Fabrication and characterization of synergistic Al-SiC-GNPs hybrid composites. Composites Part B: Engineering 2018; 154: 1–9.
12. Rao VR, Ramanaiah N, Sarcar MMM. Tribological properties of Aluminium Metal Matrix Composites (AA7075 Reinforced with Titanium Carbide (TiC) Particles). International Journal of Advanced Science and Technology 2016; 88: 13–26.
13. Kumar S, Balasubramanian V. Effect of reinforcement size and volume fraction on the abrasive wear behaviour of AA7075 Al/SiCp P/M composites-A statistical analysis. Tribology International 2010; 43: 414–22.
14. Prabu SB, Karunamoorthy L, Kathiresan S, Mohan B. Influence of stirring speed and stirring time on distribution of particles in cast metal matrix composite. Journal of Materials Processing Technology 2006; 171: 268–73.
15. Qin S, Chen C, Zhang G, Wang W, Wang Z. The effect of particle shape on ductility of SiCp reinforced 6061 Al matrix composites. Materials Science and Engineering A 1999; 272: 363–70.
16. Mishra AK, Srivastava RK. Wear Behaviour of Al-6061/SiC Metal Matrix Composites. Journal of The Institution of Engineers (India): Series C 2017; 98: 97–103.
17. Bhat A, Kakandikar G. Manufacture of silicon carbide reinforced aluminium 6061 metal matrix composites for enhanced sliding wear properties. Manufacturing Review 2019; 6: 4–9.
18. Veeresh Kumar GB, Rao CSP, Selvaraj N. Studies on mechanical and dry sliding wear of Al6061-SiC composites. Composites Part B: Engineering 2012; 43: 1185–91.
19. Faisal N, Kumar K. Mechanical and tribological behaviour of nano scaled silicon carbide reinforced aluminium composites. Journal of Experimental Nanoscience 2018; 13: S1–13.
20. Tamilanban T, Ravikumar TS. Influence of stirring speed on stir casting of SiC reinforced Al Mg Cu composite. Materials Today: Proceedings2020; doi 10.1016/j.matpr.2020.08.633.
21. Geng L, Zhang HW, Li HZ, Guan LN, Huang LJ. Effects of Mg content on microstructure and mechanical properties of SiCp/Al-Mg composites fabricated by semi-solid stirring technique. Transactions of Nonferrous Metals Society of China (English Edition) 2010; 20: 1851–5.
22. Hashim J, Looney L, Hashmi MSJ. The wettability of SiC particles by molten aluminium alloy. Journal of Materials Processing Technology

Figures

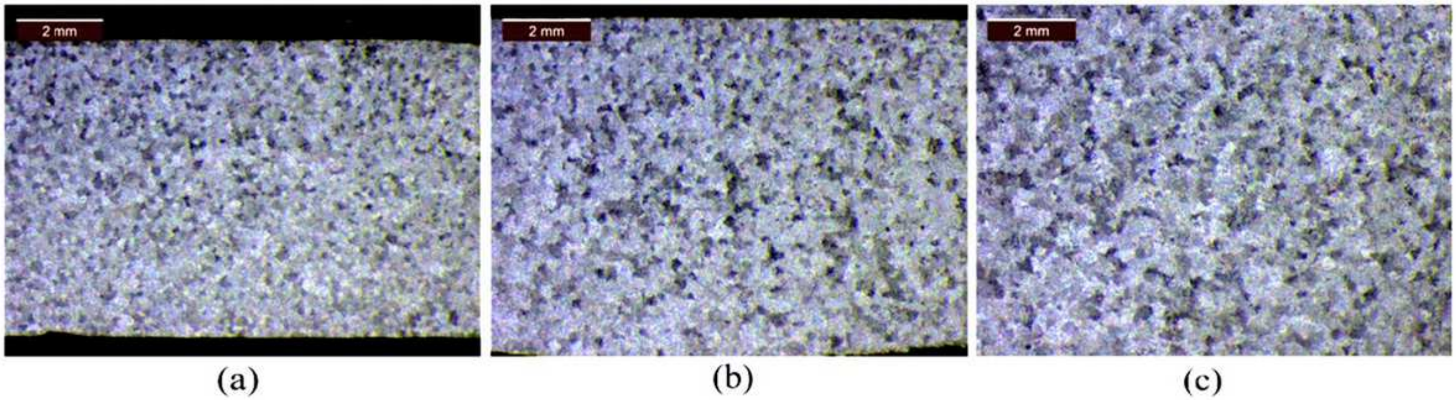

Figure 1

Macro images of composites prepared at pouring temperatures a) 630 ℃ b) 670 ℃ and c) 710 ℃

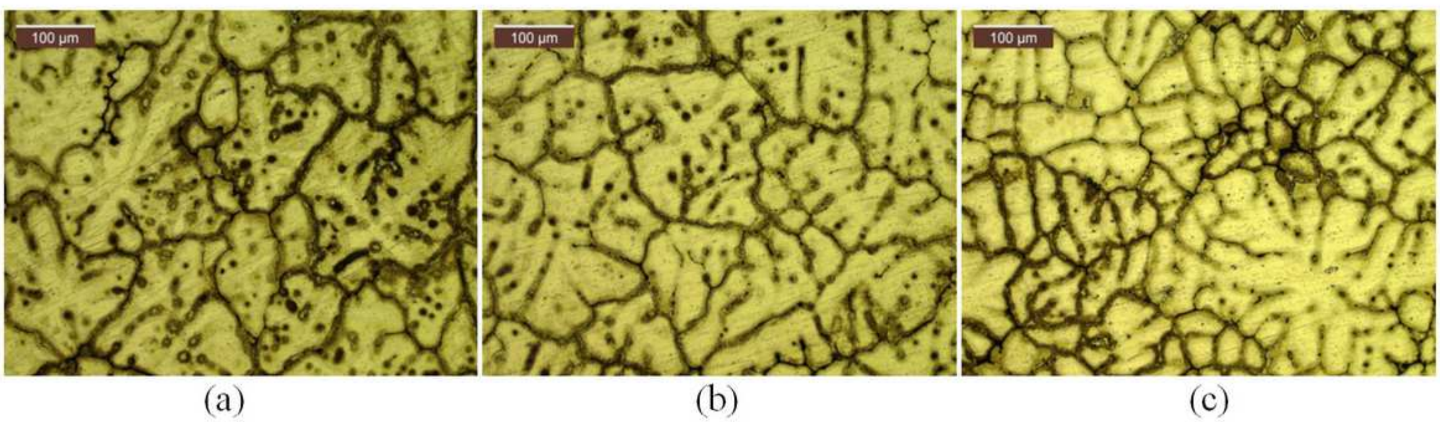

Figure 2

Optical Microstructure images of stir casted composites with three different pouring temperature a) 630 ℃ b) 670 ℃ and c) 710 ℃) 710 ℃

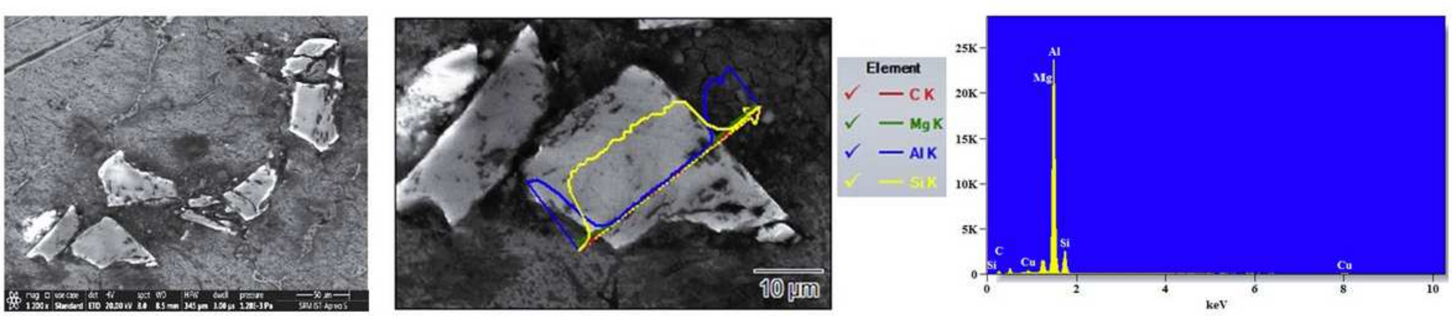

Figure 3

SEM and Line energy dispersive Xray spectroscopy (EDX) data with Spectrum of the composite (670℃ pouring temperature).

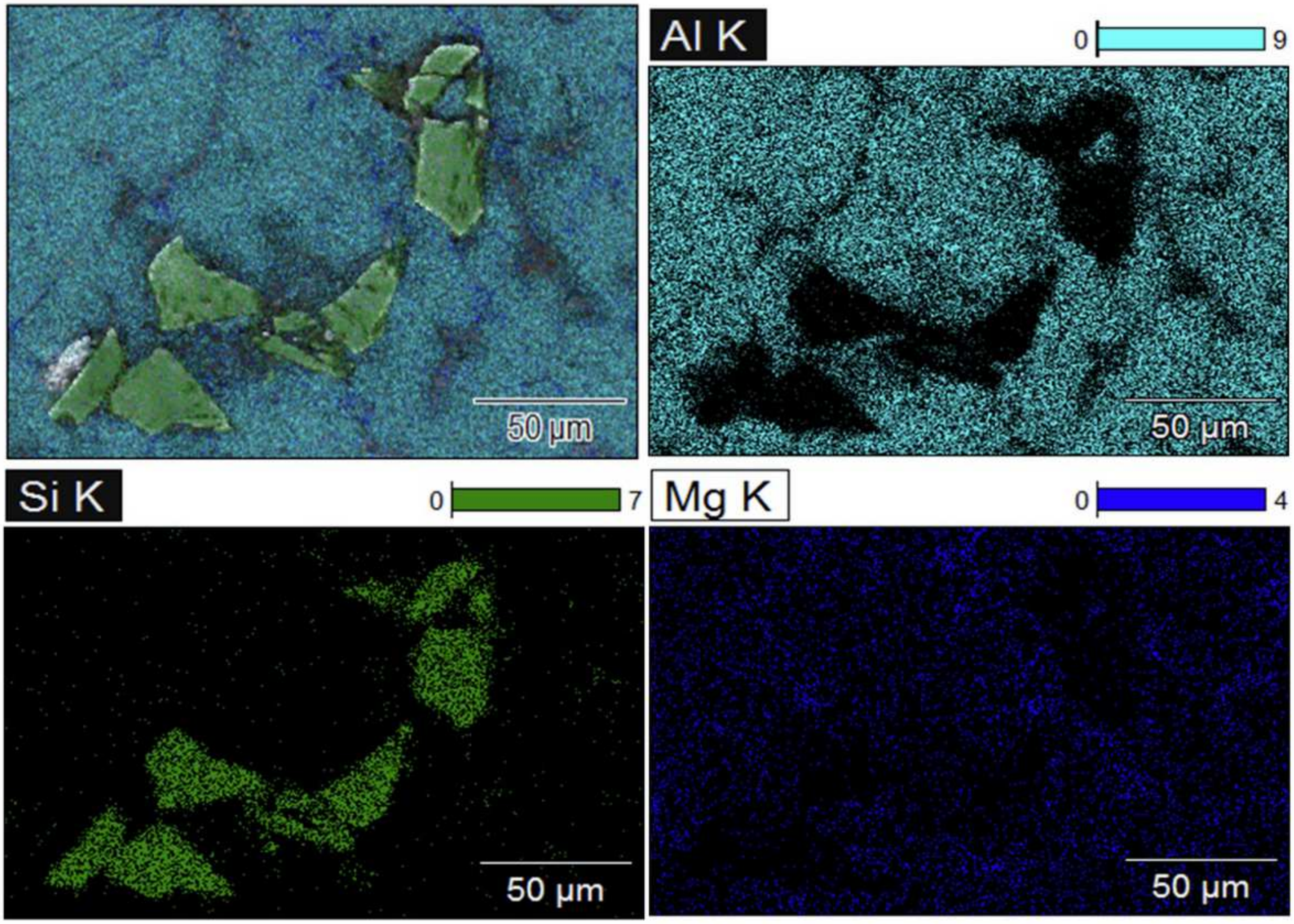

Figure 4

SEM EDX data analysis on SiC particles region of the composites

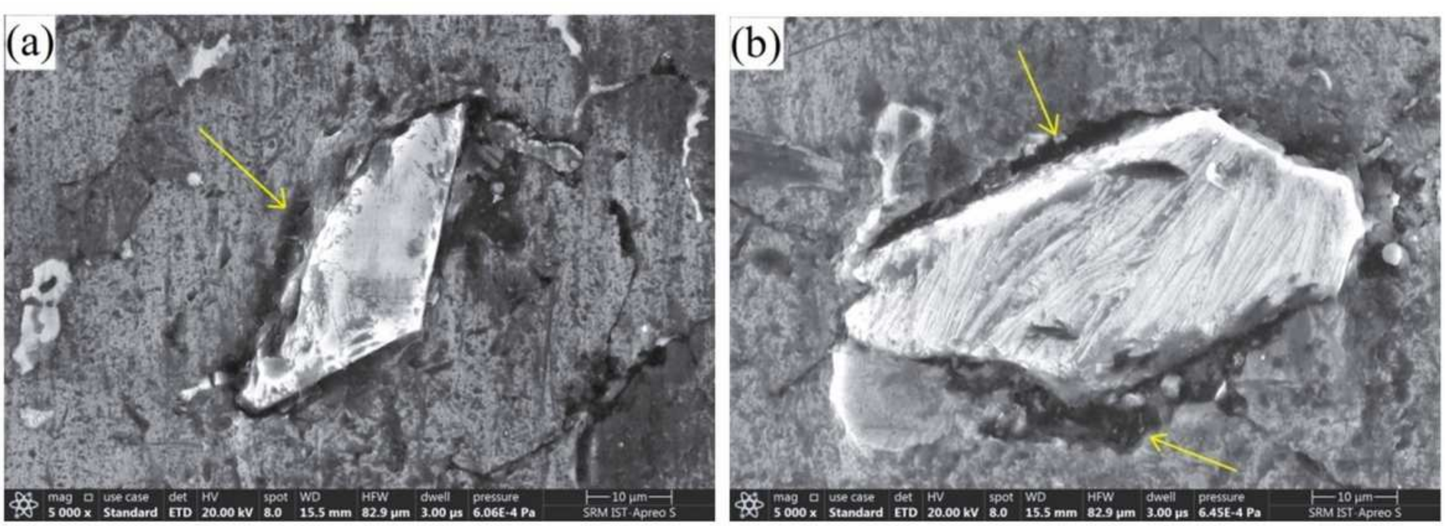

Figure 5

SEM images of composites prepared at pouring temperatures (a) 630℃ and (b) 710℃

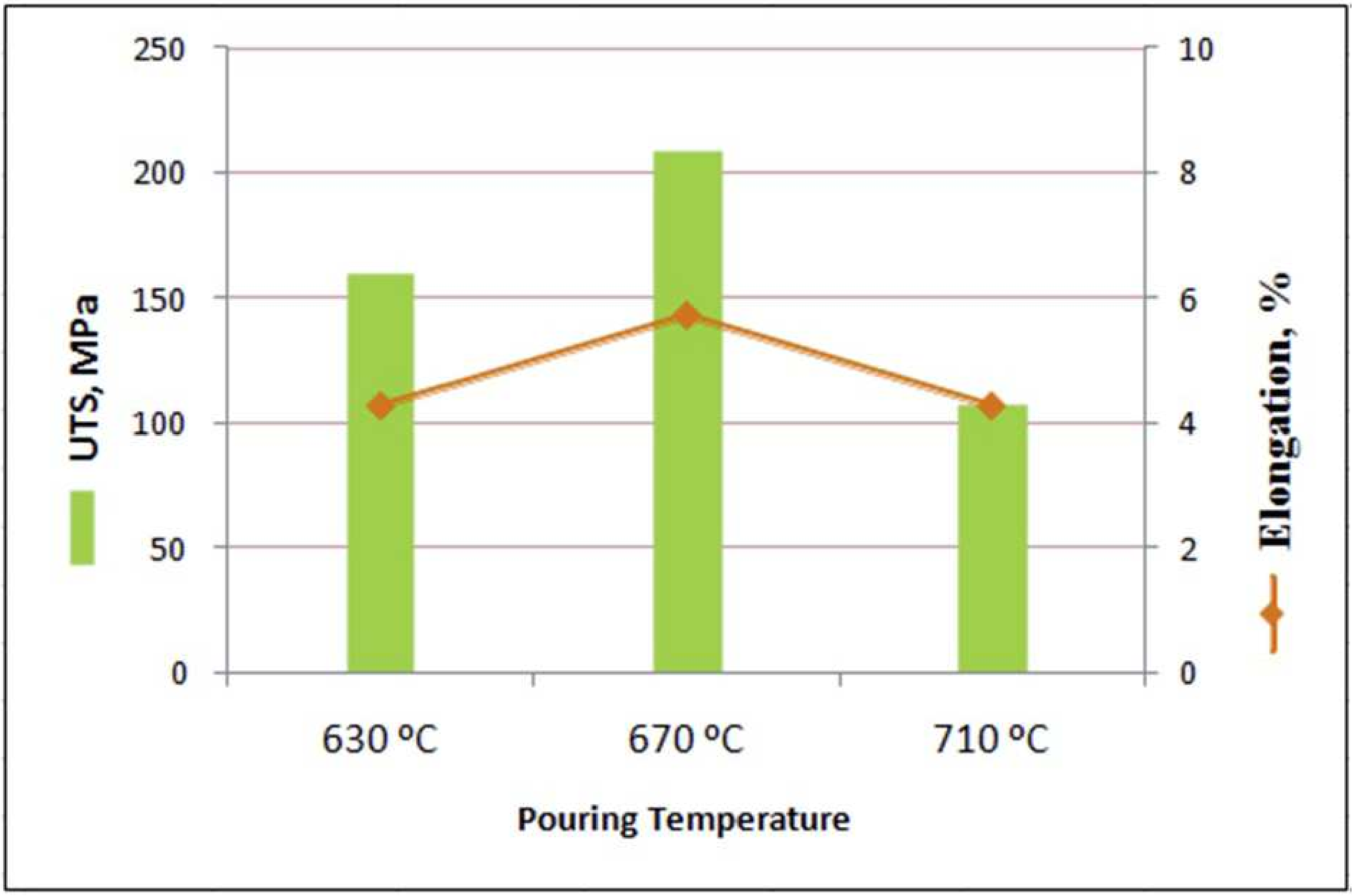

Figure 6

Mechanical properties of the composites

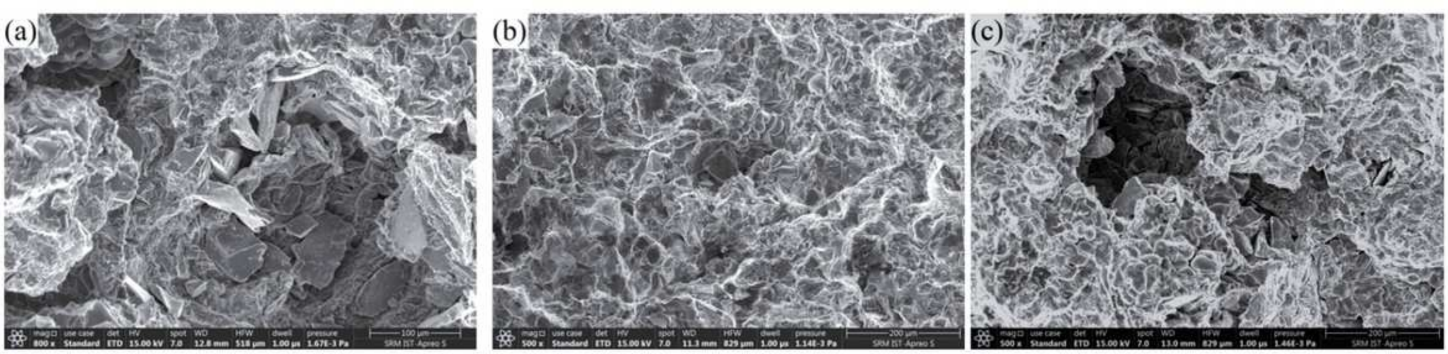

Figure 7

Fractography images of tensile failure samples of the composites prepared at pouring temperatures a) 630 oC b) 670℃ and c) 710℃