Microstructure and Mechanical Behavior of In Situ Primary Si/Mg2Si Locally Reinforced Aluminum Matrix Composites Piston by Centrifugal Casting

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Abstract: Al-Si pistons are frequently damaged by burning piston top surface due to elevated combustion temperature, and, by rubbing the first ring groove against the engine cylinder liner. To prevent from these damages, some technologies were invented, such as mounting high Ni cast iron ring around the first ring groove in Al alloy piston body and thermal resistant steel on piston top surface, and, fabricating Al composite pistons by squeeze casting for enhancing the whole or local piston performance. In this work, composite pistons locally reinforced with in situ primary Si and primary Mg2Si particles were fabricated by centrifugal casting. The microstructure characteristics, hardness and wear resistance of the composite piston were investigated and the motion characteristic of the in situ particles in centrifugal field was analyzed. The results of the experiments showed that primary Si and Mg2Si particles mixed up with each other in melt and segregated at the regions of piston top and piston ring grooves under the effect of centrifugal force. Particulate reinforced regions had a higher hardness and better wear resistance compared with the unreinforced regions and this performance increased after heat treatment. The analysis result of particle movement showed that, primary Si and primary Mg2Si particles move at approximately same velocity in the centrifugal field, because of the growth of primary Si and fusion after colliding between primary Si particles, which compromised the velocity difference of primary Si and primary Mg2Si particles caused by the difference of their densities. Research results have some theory significance and applicative value of project in development of new aluminum matrix composites piston products.

Key words: Piston, Centrifugal casting, In situ composite, Primary Si, Mg2Si

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