NEW APPROACH TO ALUMINIUM-POLYMER ALLOYS

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ABSTRACT

New approach to aluminium-polymer alloys prepared by in-situ mixing or addition of molten metal onto polymer granules will be highlighted. This concept is simple and never been attempted before due to the thermal instability and degradation of polymer. Based on basic scientific principles of Chemogenesis or Matter, it is believed that many chemical and physical interactions could occur which could be harnessed to generate new materials and applications. Three samples of different aluminium-polymer (with polymer PS, PP and ABS) were studied. The microstructures of the samples were observed under SEM. The Vickers microhardness and the concentration of aluminium in each sample were measured. The result shows that the hardness and aluminium concentration increases with the presence of polymers compared to aluminium alone

Keywords: Metallurgy, Nonferrous, Polymer

INTRODUCTION

Aluminium is light in weight, yet some of its alloys have strengths greater than structural steel. It has good electrical and thermal conductivities and high reflectivity to both heat and light. Aluminium has a density of 2.70g/cm^3. Polymers are materials consisting of giant or macromolecules, chain-like molecules having average molecular weights from 10000 to more than 1000000 g/mol built by joining many mers or units through chemical bonding [1].

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EXPERIMENTAL PROCEDURE

The mould was made by CO_2 process. Polymer was placed in the mould cavity. Aluminium ingot was melted. and poured into the mould. Casting was removed from the mould. Sample were than examined for both the hardness and microstructures with Vickers Hardness Tester and SEM, respectively.

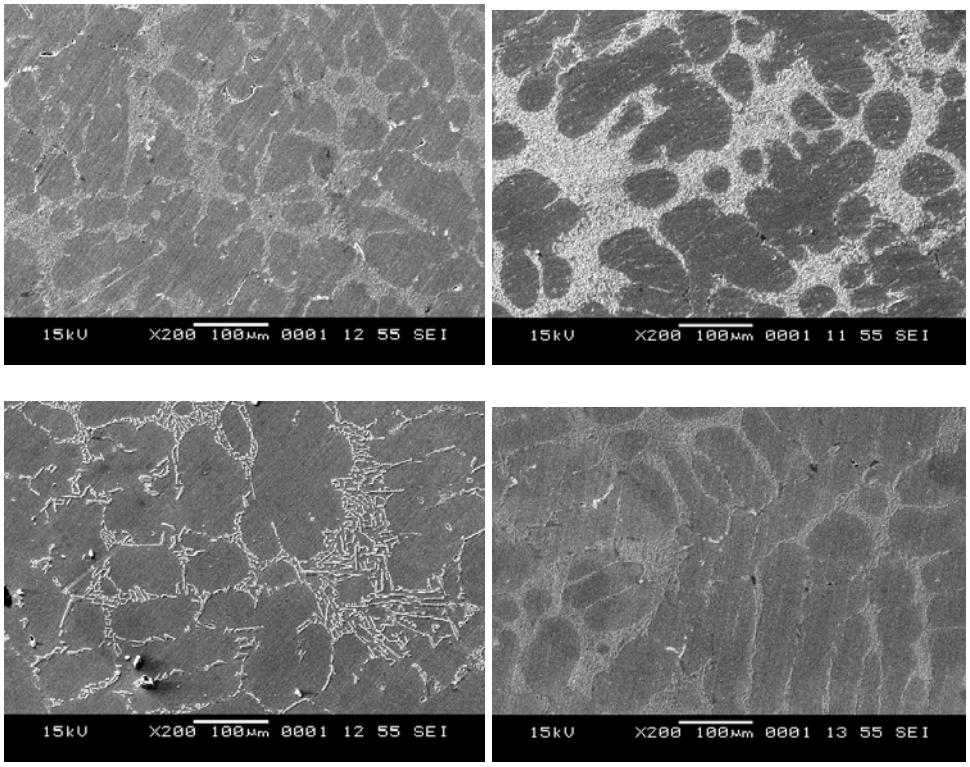
RESULTS

Material	Hardness number (HV)
Pure Al	47.83
Al-PS	69.37
Al-PP	70.87
Al-ABS	72.83

Table 1: Vickers Microhardness measurements

Material	Al concentration (%)
Pure Al	55.136
Al-PS	88.514
Al-PP	91.624
Al-ABS	93.776

Table 2: Al concentration for each material



DISCUSSION

PS, PP and ABS are thermoplastics materials selected for their difference amorphous namely semi crystalline and a copolymer .The degree of crystallinity increases from PS, PP to ABS. For linear polymers such as PE and PP, crystallization is easily accomplished because there are virtually no restrictions to prevent chain alignment when they are melted and subsequently cooled[2]. For amorphous and copolymers such as PS and ABS,respectively in which the presence of bulky groups at the backborne chains.a greater tendency for the development of noncrystallinity. In the present study (Table 1) reveals that the hardness of the Al increases with the addition of polymer to form alloys. Among the aluminium-polymer alloys, the hardness increases with the decrease in polymer crystallinity. From Table 2, Al concentration of the polymer also increases with the decrease in polymer crystallinity. The increased hardness of aluminium-polymer alloys if compared to pure Al, is due to the substitution of polymer molecules into the opening

voids among the Al atoms. Polymer acts as a barrier to dislocation motion during plastic deformation. Crystalline polymers are usually stronger and more resistant to dissolution and softening by heat [2]. Thus, the lower the crystallinity, the easier the dissolution occurred to form smaller molecules. So, more voids can be filled. This in turn strengthen the alloys.

CONCLUSION

Aluminium-polymer alloys may be a new emerging engineering material. It can be used to replace conventional aluminium alloys. Moreover, it offers attractive properties such as high hardness and aluminium concentration with the decrease of polymer crystallinity.

REFERENCES

[1] D.R.Askeland, P.P.Phule, Essentials of Materials Science and Engineering, Thomson Canada Limited, pp.477.
[2] W.D.Callister, Materials Science and Engineering An Introduction, 6th edition, John Wiley & Sons, Inc., pp. 471.
[3] L.Horath, Fundamentals of Materials Science for Technologists Properties, Testing, and Laboratory Exercises, Prentice Hall, pp.102.