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Corrosion behaviour of Magnesium/glass microballoon syntactic foams targeting engineering and biomedical applications

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Metal Matrix Syntactic Foams (MMSFs) are a special class of composites in which hollow particles are dispersed through the metal matrix. The presence of hollow reinforcements imparts properties to the composite similar to that would be found in monolithic cellular materials. Such lightweight syntactic foams possessing superior properties are of continuing interest in automotive, aerospace and marine sectors to reduce weight while simultaneously increasing fuel economy required for ever-increasing stricter environmental regulations and stringent service conditions. In this context, Magnesium-based materials are emerging strongly primarily due to their low density, combination of better specific strength (σ/ρ), damping characteristics and impact resistance. These properties can still be enhanced by a further reduction in density through the development of Magnesium-based syntactic foams. Further, Magnesium (Mg) being biocompatible offers huge potential for use as bioresorbable materials for degradable bone replacement implants due to its favourable corrosion and mechanical properties. However, high corrosion kinetics and localized corrosion progress limit wide scale implementation of Magnesium based materials in marine environments and clinical implantable devices. This dire requirement necessitated the need for an investigation on corrosion behaviour of hollow glass microballoon (GMB) reinforced Magnesium syntactic foams. As environment of a human body is very aggressive to metallic products, the positive corrosion test results under simulated conditions of a human body provide a good indicator of the corrosion resistance of the material for other applications. This research presents a comparative study of the corrosion of Mg/GMB syntactic foams in Hank's solution and in 3.5% NaCl solution for a maximum duration of 28 days. The developed syntactic foams were found to reveal promising corrosion behaviour along with ~28% reduction in density as compared to pure Mg. The observed increase in corrosion resistance is correlated with intrinsic microstructural changes arising as a consequence of the presence of the hollow GMB particles.

Recent Publications

1. Manakari, V., Parande, G., Doddamani, M. and Gupta, M., 2017. Enhancing the ignition, hardness and compressive response of Magnesium by reinforcing with hollow glass microballoons. *Materials*, 10(9), p.997.
2. V. Manakari, G. Parande, M. Doddamani, G. K. Meenashisundaram, M. Gupta, *Adv. Mater*. Lett. 2017, 8, 1171.
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4. Nguyen, Q.B., Sharon Nai, M.L., Nguyen, A.S., Seetharaman, S., Wai Leong, E.W. and Gupta, M., 2016. Synthesis and properties of light weight Magnesium–cenosphere composite. *Materials Science and Technology*, 32(9), pp.923-929.
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Biography

Manoj Gupta is Associate Professor at Department of Mechanical Engineering, National University of Singapore. He has been working on Lightweight Metals (particularly Magnesium based Materials) over past 25 years. His current research is focused on development of Lightweight HEA, Ignition resistant Magnesium based nanocomposites, Magnesium syntactic foams and Additive Manufacturing (3D Printing) of Magnesium.

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