Development of Shape Memory Alloy Smart Composites

- A New Method for Fabricating SMA Smart Polymer Matrix Composites -

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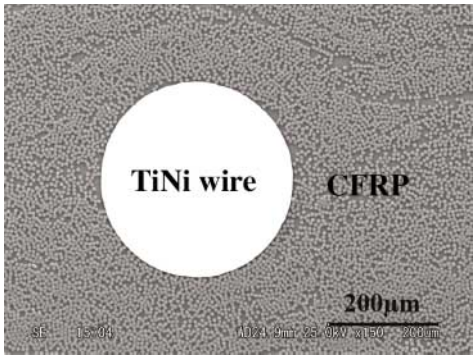
Shape memory alloy (SMA) smart composites, in which SMA wires or plates are embedded in composites, are attracting much attention recently. However, one problem in the fabrication process is that the curing temperature of thermoset composites far exceeds the reverse transformation temperatures of TiNi SMA, and special fixture jigs have to be used during fabrication. This makes the fabrication process of SMA smart composites complicated and not suitable for practical application. We have developed a new, simple, and effective method to fabricate TiNi SMA smart composites. The method consists of using heavily cold-worked TiNi wires to increase the reverse transformation temperatures, and of using flash electrical heating of the TiNi wires after fabrication in order to avoid damaging of the matrix around wires. By proper cold working and subsequent electrical heating, the reverse transformation temperature (As) and recovery stress of TiNi alloys were well controlled, and the SMA smart composites were fabricated without using special fixture jigs.



SEM image of the cross section of fabricated TINi/ CFRP smart composite

Bulk Amorphous Magnesium Alloy

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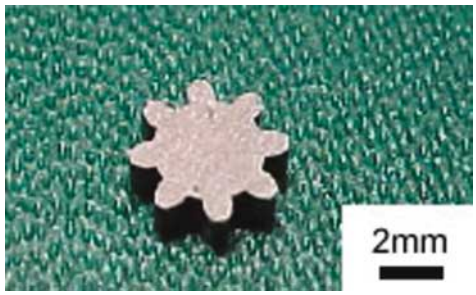
A new process was developed to prepare a new magnesium alloy with a high strength and corrosion resistance. Amorphous Mg-15at%Ni-10at%Si powder was synthesized by a mechanically alloying of elementary Mg, Ni and Si powders. The obtained powder showed a crystallization temperature of 573K. The amorphous powder was consolidated by a pulsed current sintering with a high pressure of 500MPa at 473K. The obtained bulk amorphous magnesium alloy showed a high compressive strength of 303MPa and a much higher corrosion resistance than a conventional one. The developed process enabled us to fabricate a bulk amorphous magnesium alloy with a commercial part of gear.



External appearance of bulk amorphous magnesium gear