Nanometal/Polymer Hybrid Material
Makes Lighter, Stronger Snowboard Bindings

Typically, designers and manufacturers of snowboard bindings have been restricted to the use of conventional materials and manufacturing methods. For example, many of Union Binding Co.'s (Colico, Italy and Seattle, Wash.) past binding designs use machined aluminum, or die-cast magnesium heel cups (the same is true for most other snowboard binding manufacturers). Machined aluminum is typically expensive, and die-cast magnesium may not have the required mechanical properties to meet demanding applications. Additionally, both of these materials are denser than newer, cost-competitive composite materials.

Union Binding turned to PowerMetal Technologies, Carlsbad, Calif., (an affiliate of Integran Technologies Inc., Toronto, ON, Canada) for its next materials-based breakthrough in snowboard-binding technology. The company wanted to reduce the overall weight of their flagship snowboard binding. Specifically, they wanted a reduction in weight of the binding heel-cup component, while maintaining all of its original mechanical properties such as strength and stiffness. Union Binding asked PowerMetal to significantly reduce (by more than 20%) the weight of the already lightweight heel cup component by using PowerMetal's novel nanometal/polymer hybrid material called Nanovate NP. This was a significant departure from Union Binding's typical aluminum heel cups (Fig. 1).

Fig. 1 — *Union Binding's Force-SL snowboard binding with a conventional extruded aluminum heel-cup component.*

Hybrid composite: a new approach

Nanovate NP nanometal/polymer material is an engineered hybrid consisting of low-cost, injection-molded polymer (used as a substrate core) and ultra-high strength nanometal (used as a structural coating). Nanometal is a special type of metal that has a crystalline grain structure on the nanometer scale. In contrast, typical metals have a grain structure measured in the microns or millimeter scales. Nanometals typically exhibit significantly improved mechanical properties compared with their conventional larger grain size counterparts, without compromising ductility or modulus of elasticity. This marked improvement in mechanical properties is the enabling feature of the Nanovate NP approach in part design. Combining injection molded polymers with nanometals yields a new material with unique properties that are unmatched by conventional materials.

By varying the volume fractions of its two constituents, the strength, stiffness, and density of Nanovate NP hybrids can be tailored to match the requirements of the specific application. A Nanovate NP heel cup used on the latest Union Binding snowboard binding is shown in Fig. 2.

Fig. 2 — *Union Binding's Force-MC snowboard binding with a lightweight nanometal/polymer hybrid heel cup.*

Benefits of Nanovate NP

Switching from conventional materials to Nanovate NP for the heel-cup material lowers weight without sacrificing strength. The mass of the new hybrid heel cup is 61 g compared to 88 g for machined aluminum and 80 g for die-cast magnesium. This translates into a weight savings of approximately 30% and 25% relative to the aluminum and magnesium alternatives, respectively.

In pull tests that simulate stresses experienced during actual use, the hybrid heel cups proved to be four times stronger than polymer counterparts. Moreover, the hybrid parts matched the strength of the equivalent machined aluminum parts, but have a 20% improvement in deformation resistance. This means better force transmission from the rider to the snowboard providing better control during demanding maneuvers.

Another benefit is increased durability of the heel cup, a direct result of the high hardness of the Nanovate coating (comparable to that of tool steel). Figure 3 shows a comparison of the hardness of Nanovate and its aluminum and magnesium competitors.

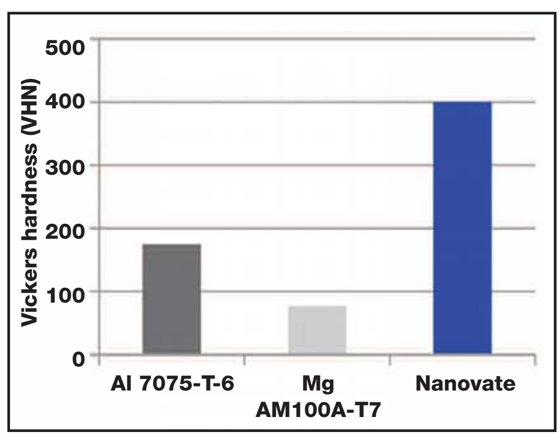

Fig. 3 — *Hardness of Al 7075-T6, Mg AM100A-T7, and Nanovate N1010 materials used in heel-cup component.*

Designing with Nanovate NP

Using Nanovate NP material for the heel cup component provided Union Binding greater design flexibility compared with conventional manufacturing methods like machining, forming, and die casting. The first step in the design process was the selection of a qualified polymer resin (DuPont Zytel 70G40MF polyamide 66 was selected in this case) for use with the nanometal coating process, which also fit the other requirements of the heel cup component (e.g., operating temperature and stiffness). Next, the heel cup geometry was optimized for the nanometal coating process by following a set of design principles that helped maximize the uniformity of properties across the entire part. After injection molding, the heel cup component was activated using a proprietary process, metallized with a thin copper layer, and coated with Nanovate N1010 nickel alloy through a wet chemical deposition process. The bare and nanometal-coated heel cup component is shown in Fig. 4. ❍

Fig. 4 — *Nanometal/polymer hybrid heel cups showing the bare, copper-metallized, and Nanovate-coated stages.*

Integran Technologies Inc. pioneered the use of nanometal coatings in the aerospace, defense, and industrial sectors.

PowerMetal uses Integran's Nanovate in the sports and leisure industry to make high-performance, lightweight, and durable parts. www.powermetal.com.

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