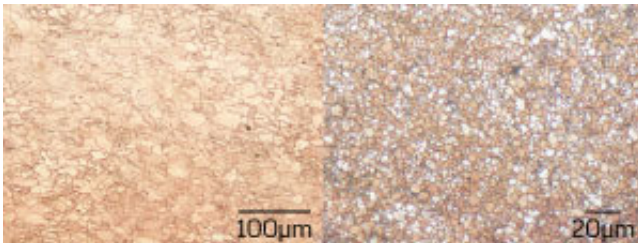


Magnesium alloy as a lighter alternative to aluminum alloy

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Orthogonal groove strain pressing and fast annealing dramatically shrinks the grain size of AZ31 magnesium alloy, resulting in increased strength and room temperature ductility. Before processing (left), after processing (right). Credit: Elsevier

Magnesium alloy can be made stronger and more workable by hot pressing under optimized conditions to produce an ultra-fine crystalline structure, A*STAR researchers have shown. The improved material means magnesium alloy will have broader applications as an ultra-light structural material.

Aluminum alloy is currently the go-to light metal for many structural applications, from aircraft fuselages to smartphone bodies. It is light, corrosion-resistant and is relatively easy to shape, weld and work. Alloys of [magnesium](#) are up to one-third lighter than [alloys](#) of aluminum, and are particularly promising for applications where weight is critical: they have the added benefit of being more dent-resistant and more

machinable, and better able to shield electromagnetic radiation and dampen vibrations, than alloys of aluminum.

The trade-off with magnesium is that it is notoriously difficult to work with, requires high temperatures for formability, and has generally lower strength. Finding a way to improve the mechanical properties and workability of [magnesium alloys](#) could open many new applications for the material with real-world benefits like improved fuel economy in aircraft, watercraft and land vehicles, and lighter mobile phones.

Kai Soon Fong and colleagues from the Singapore Institute of Manufacturing Technology and Nanyang Technological University have now devised a pre-processing method that significantly improves the mechanical strength and ductility of AZ31, the most widely used magnesium alloy.

"We have shown that the properties of commercial AZ31 magnesium sheets can be enhanced by severe plastic deformation using an orthogonal constrained groove pressing technique with fast post-annealing," says Fong.

Constrained groove pressing involves repeated pressing of a thin sheet of metal, such as magnesium alloy, between heated, finely corrugated dies. This stretches—or strains—the material over very narrow domains, causing plastic deformation while preventing damage and inducing the microscopic crystal grains to recrystallize into a finer microstructure. By turning the sheet by 90 degrees between each pressing step, the material is repeatedly strained until the entire sheet has been processed.

The material is then heated, or annealed, to remove residual stress, but at a faster heating rate and shorter time than usual, to prevent the grains from enlarging again.

"By optimizing the processing temperature and strain rate, we were able to achieve an ultrafine-grained microstructure, which does not physically change the alloy, but improves its mechanical properties through grain refinement," says Fong. "This processing led to improved [mechanical strength](#) and ductility, making it tougher and easier to shape at room temperature."

More information: Kai Soon Fong et al. Tensile flow behavior of AZ31 magnesium alloy processed by severe plastic deformation and post-annealing at moderately high temperatures, *Journal of Materials Processing Technology* (2017). [DOI: 10.1016/j.jmatprotec.2017.03.025](https://doi.org/10.1016/j.jmatprotec.2017.03.025)

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