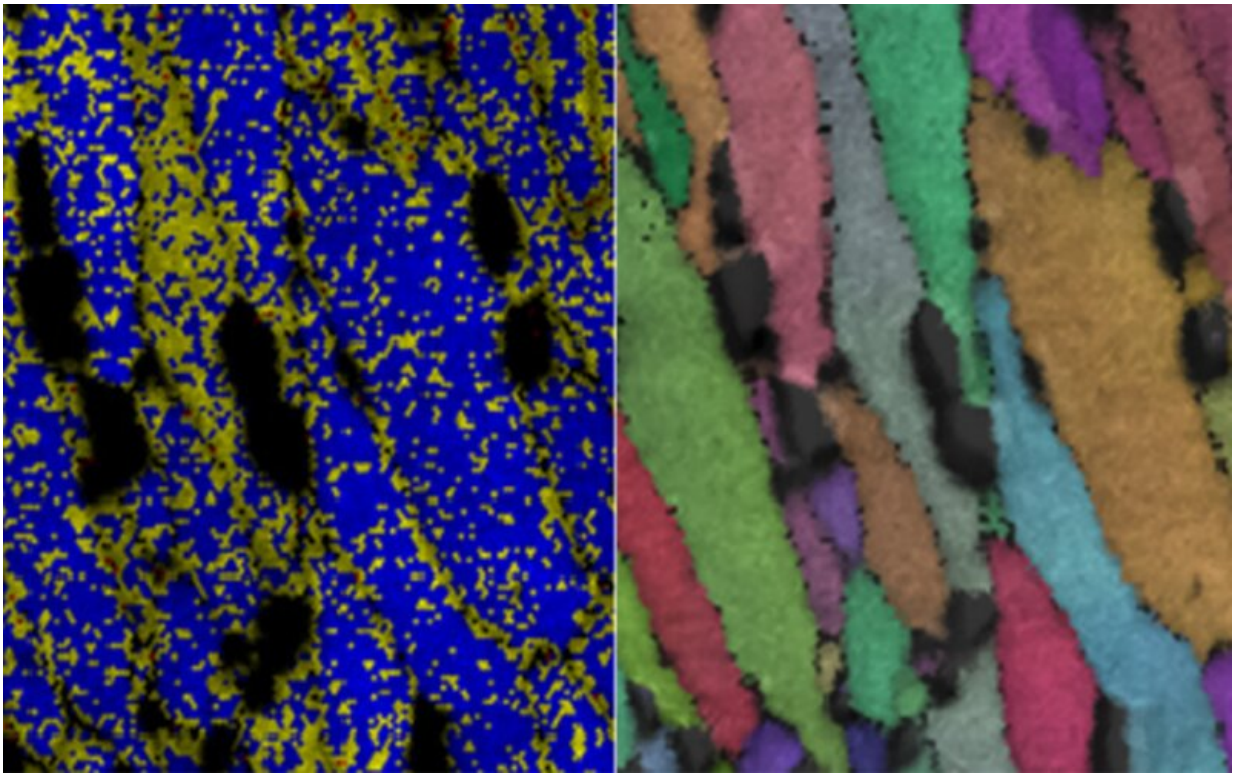
Scientists use neutrons to discover strengthening behavior in alloys

January 19 2023



A team of ORNL researchers used neutron diffraction experiments to study the 3D-printed ACMZ alloy and observed a phenomenon called “load shuffling” that could inform the design of stronger, better-performing lightweight materials for vehicles. Credit: ORNL, U.S. Dept. of Energy

Oak Ridge National Laboratory researchers have identified a mechanism in a 3D-printed alloy—termed "load shuffling"—that could enable the

design of better-performing lightweight materials for vehicles.

One way to improve energy efficiency in vehicles is to make them lighter with aluminum-based materials. Researchers monitored a version of ORNL's ACMZ—aluminum, copper, manganese and zirconium—alloy for deformation that occurs when the material is under persistent mechanical stress at high temperatures.

Using neutron diffraction, researchers studied the material's atomic structure and observed that the overall stress was absorbed by one part of the alloy but transferred to another part during deformation. This back-and-forth shuffling prevents strengthening in some areas.

"Neutrons offer opportunities to study metallurgical phenomena in multiphase structural materials," ORNL's Amit Shyam said. "We've gained unprecedented insight into elevated-temperature material behavior that will allow us to design improved aluminum alloys for extreme conditions."

The research is published in the journal *Acta Materialia*.

More information: Richard A. Michi et al, Load shuffling during creep deformation of an additively manufactured AlCuMnZr alloy, *Acta Materialia* (2022). DOI: 10.1016/j.actamat.2022.118557

Provided by Oak Ridge National Laboratory