Reindeer Antler Secrets Inspire Stronger Materials

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Reindeer smash their antlers together in mighty battles over territory or mates. The tough material of the antlers resists breaking in spite of these challenges.

Now scientists are studying what makes reindeer antlers so strong and resistant to fracture. Why is the amazing strength of reindeer antlers such a secret that we are only just learning it now?

People with Ph.D.s or engineering degrees refer to reindeer bashing heads as a "cyclical load" - that is, the deer antlers crash together, absorbing great impact, and the deer back off to repeat the behavior. The thing that makes biomimicry of these materials a challenge goes under the scientific name "hysteresis", which means that the way the antler material behaves in the second or third round of clashes differs from how it behaves in the first encounter.

Because of this changing behavior dependent upon the history of the use of the material, the mechanical properties are difficult to model. But a team from Queen Mary University of London has published a paper in ACS *Biomaterials Science & Engineering* furthering our understanding of the secret that makes antlers such great crowning glory for the herds roaming the northern tundra.

They found that two key properties underlie antlers' toughness and resistance. The staggered construction of the tiny (nano-sized) fibers could be seen in x-ray diffraction studies of the antlers, which scientists were able to view during loading of the antlers.

State-of-the-art computer models the team derived from their physical studies point to the secret property that makes antlers work: in addition to the stiff, staggered fibers, they found that the interface between each of the fibers must be elastic or damageable, at least capable of giving way and allowing the fibers to slide past each other in absorbing the impact.

The team believes that this work can be used to build up similar materials in additive manufacturing processes. As additive manufacturing becomes more widespread, the development of engineered materials will become critical to constructing products with the same or better performance that our old-fashioned construction techniques provide. If we can learn from mother nature, so much the better.