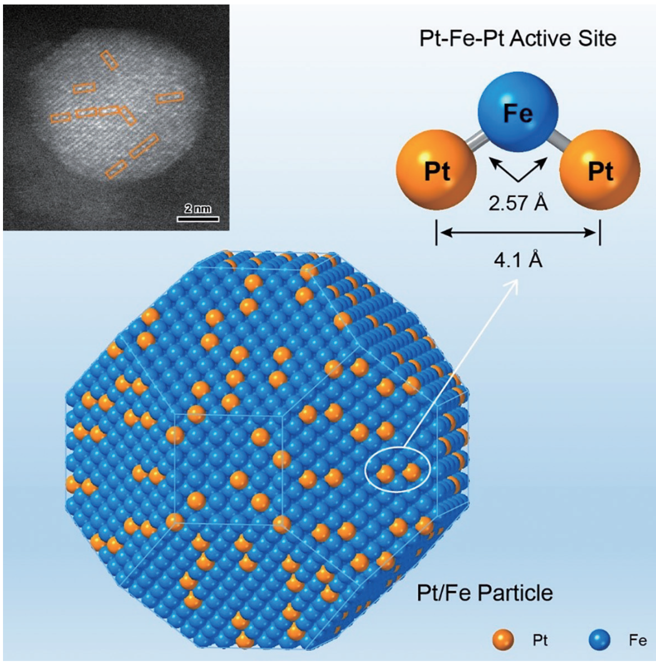
Atomic Tuning for Perfect Catalysts

Hydrogenation catalysts frequently impose a compromise between activity and selectivity, where maximizing one property inevitably diminishes the other. Researchers from the Dalian Institute of Chemical Physics (DICP) of the Chinese Academy of Sciences, in collaboration with scholars from University of Science and Technology of China and the Karlsruhe Institute of Technology in Germany, cracked this dilemma by engineering bimetallic catalysts with atomic precision—a breakthrough that boosts hydrogenation efficiency by 35-fold while maintaining pinpoint accuracy, resolving the stubborn activity-selectivity paradox.



Tailoring active sites on bimetallic catalysts with atomic precision. (Graphic: ZHOU Di)

Published in *Chem* on January 3, 2025, the study showcases platinum-iron clusters (*Pt-Fe-Pt heterotrimers*) where isolated Pt atoms bind to Fe nanoparticles. By precisely tuning their bonding structure, the team enabled these clusters to selectively hydrogenate crotonaldehyde's C=O bond—producing crotyl alcohol with 99% preference over competing reactions. The atomic arrangement allows one Pt atom to anchor the substrate, while adjacent Fe and Pt sites activate and hydrogenate target bonds—a "lock-and-key" mechanism decoded at molecular resolution. This atomic-scale tailoring—combining nanocluster synthesis with surface alloying—sets a blueprint for next-generation catalysts, merging industrial efficiency with molecular precision.

Solid Hydrogen Storage Scale-up

A 150-ton/year magnesium hydride pilot plant in Yulin, Shaanxi. (Graphic: CUI Yajun and CAO Hujun)

Hydrogen storage—a key hurdle for clean energy—has advanced with a pilot plant producing 150 tons of magnesium hydride annually since January 10, 2025. Developed by a research team at the Dalian Institute of Chemical Physics (DICP) of the Chinese Academy of Sciences, the project uses a novel "one-pot" method to synthesize magnesium-based materials that store hydrogen safely and effi-

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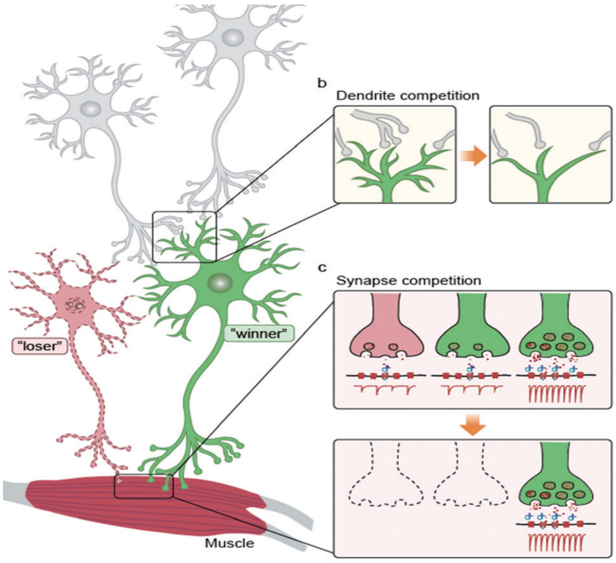
ciently. Magnesium hydride's high capacity and stability make it ideal for large-scale hydrogen transport and hydrogen-thermal-electric coupling, supporting a transition to sustainable energy. The pilot, located in Yulin, Shaanxi, focuses on optimizing production of these materials—crucial for bridging hydrogen and fossil energy systems and enabling renewable energy storage.

Genes to Beat Parasite

Researchers from the Institute of Genetics and Developmental Biology (IGDB) of the Chinese Academy of Sciences, with collaborators, identified two sorghum genes (*SbSLT1* and *SbSLT2*) that block *Striga*—a parasitic plant, also known as "witchweed," that causes $1.5 billion annual losses in Africa by draining crop nutrients. Published in *Cell* (February 12, 2025), the study shows that these genes regulate strigolactones (SLs), hormones sorghum releases to attract beneficial fungi but also trigger *Striga* germination. Editing the genes reduced SL secretion by 67% to 94%, starving *Striga* and cutting field infestation. The team also pinpointed a conserved amino acid in SL transporters across maize, rice, and tomatoes, enabling broad resistance breeding. In trials, gene-edited sorghum reduced yield loss by 49% to 52% in *Striga*-prone regions like Africa and Asia. This new finding offers a global strategy to engineer parasite-resistant crops, with ongoing tests in maize and tomatoes poised to boost resilience in vulnerable farmlands.

Silencing "Witchweed" (split image): Left—*Striga*, a parasitic plant nicknamed witchweed that drains nutrients and slashes harvests; right—gene-edited sorghum reduces strigolactone (SL), lowering *Striga* germination and mitigating yield loss. (Graphic: XIE Qi)

Brain Cells' Survival Game



Neural cell competition (NCC), a brain cells' "survival game," occurs at many levels. (Graphic: IGDB)

The brain's cellular landscape—a battleground where neurons and glial cells vie for survival—shapes cognition from infancy to old age. Researchers from the Institute of Genetics and Developmental Biology (IGDB) of the Chinese Academy of Sciences have uncovered how neural cell competition (NCC)—a process once

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thought confined to early development—governs brain health across the lifespan, offering clues to combat age-related decline.

Published in *National Science Review* on February 12, 2025, the study reveals that NCC maintains neural network precision by regulating interactions between neural progenitors, neurons, and glial cells. However, as aging disrupts this balance—triggering neuronal loss or glial overgrowth—the same mechanism accelerates cognitive decline and neurodegenerative diseases like Alzheimer's.

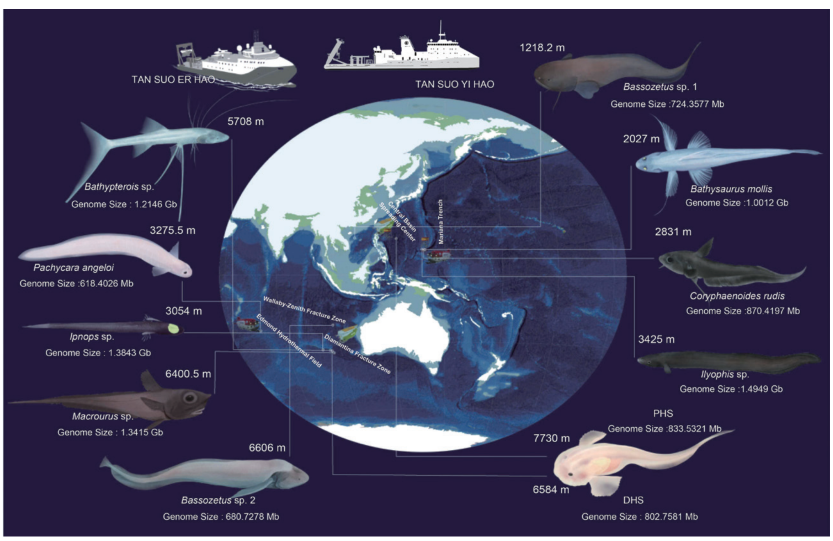
The study highlights NCC's reach beyond neurons: oligodendrocyte precursor cells, for instance, compete to mature into myelin-producing cells, with dysregulation linked to impaired information processing in conditions like multiple sclerosis. These findings reframe brain aging as a cellular "survival game," where skewed competition erodes resilience.

By identifying key signaling pathways in NCC, the research opens avenues for therapies to tilt this competition in favor of healthy cells—potentially preserving cognition and slowing neurodegeneration. The work underscores the brain's dynamic cellular ecosystem as both a vulnerability and a target for interventions in aging populations.

Deep-sea Evolution Unlocked

The hadal zone—Earth's deepest oceanic trenches below 6,000 meters—has long been considered a lifeless abyss. Researchers from the Institute of Hydrobiology (IHB) and the Institute of Deep-Sea Science and Engineering (IDSSE), both under the Chinese Academy of Sciences, together with collaborators from Northwestern Polytechnical University, recently decoded how fish thrive in this extreme realm through two evolutionary pathways while uncovering alarming traces of human pollution in these pristine ecosystems. Their discovery was published in *Cell* on March 6, 2025.

By analyzing 11 deep-sea fish species sampled across trenches and hydrothermal vents (1,218–7,730 meters), the team revealed two distinct colonization routes: the "ancient survivors" predating the Cretaceous mass extinction and the "new immigrants" dominating post-extinction. This dual-pathway model explains how vertebrates adapted to crushing pressures and near-freezing darkness—a feat partly enabled by a convergent mutation in the *rtf1* gene that boosts transcriptional efficiency under extreme pressure.



Sampling information and morphological characteristics of 11 deep-sea species. (Graphic: IHB)

The study also overturned the long-held trimethylamine N-oxide (TMAO) hypothesis of deep-sea adaption—which claims organic osmolyte levels scale with depth to counteract the destabilizing effects of high hydrostatic pressure—by showing this trend breaks beyond 6,000 meters. While TMAO remains vital for survival at moderate depths, the discovery of pressure-resistant genetic mechanisms in hadal species reshapes our understanding of deep-sea adaptation. This highlights evolutionary flexibility, where organisms employ multiple strategies—biochemical (TMAO) and genetic (*rtf1* efficiency)—to thrive under crushing pressures.

More critically, high concentrations of polychlorinated biphenyls (PCBs) were detected in Mariana Trench snailfish livers, confirming synthetic pollutants now permeate Earth's remotest ecosystems—a stark reminder of humanity's planetary footprint.

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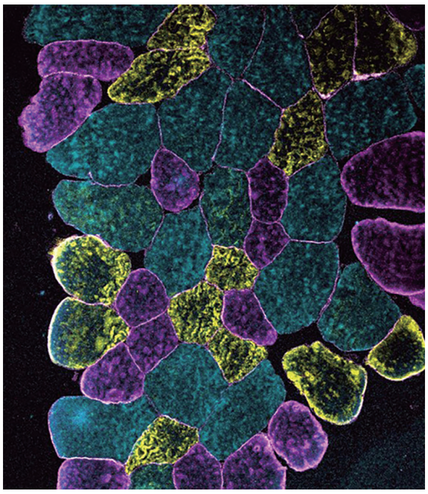
Double Grain Boost

Sorghum, a drought-resistant cereal crop crucial for global food security, typically produces single seeds per spikelet. A team of researchers from the Institute of Genetics and Developmental Biology (IGDB) of the Chinese Academy of Sciences and the Sun Yat-sen University in Guangzhou recently identified a genetic mechanism that enables some varieties to develop double-grain spikelets, significantly boosting yields. By analyzing three genetic populations, scientists traced this trait to a 35.7-kilobase chromosomal inversion activating *DG1*—a gene that encodes a protein regulating floral meristem development.

The 35.7-kilobase inversion at the *DG1* promoter reduces repressive histone marks, ramping up the gene's expression. This prevents lower florets from aborting, allowing two grains per spikelet instead of one. Field trials showed *DG1*-enhanced sorghum increased grain count by 40% to 46% per panicle and raised total yield by 10% to 14%, with no adverse effects on plant growth or flowering. Notably, the smaller grains linked to *DG1* have higher heat resistance and surface area—traits prized by China's liquor giants like Moutai and Wuliangye for brewing. The gene offers a dual benefit: higher yields for food security and optimized raw materials for industrial use.

Representative mature panicle and spikelet morphology of single-grain and double-grain. (Graphic: Adapted from Zhang *et al.*, 2025)

Muscle Rejuvenator



Fiber-type distribution in aged cynomolgus monkey skeletal muscle (cross-sectional view). (Graphic: LIU Guanghui's lab, IOZ)

The "longevity protein" SIRT5 could hold the key to delaying age-related muscle decline. A study led by researchers from the Institute of Zoology (IOZ) of the Chinese Academy of Sciences and Capital Medical University in Beijing reveals that SIRT5 mitigates skeletal muscle aging by blocking pro-inflammatory pathways. Published in *Nature Metabolism* on March 14, 2025, the work identifies SIRT5's interaction with protein kinase TBK1 as critical to preserving muscle mass and function.

Using primate models, the team observed hallmark aging traits—shrinking muscle fibers, chronic inflammation, and depleted stem cells—linked to reduced SIRT5 levels. Restoring SIRT5 in aged mice via gene therapy reversed these effects: after five weeks, treated mice showed improved strength, enlarged muscle fibers, and reduced inflammation. The research proposes SIRT5-targeted therapies as a viable strategy to combat age-related muscle deterioration and associated chronic diseases. Unlike existing interventions, this approach addresses the root molecular cause of muscle aging, offering potential for broad clinical applications.

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