Materials

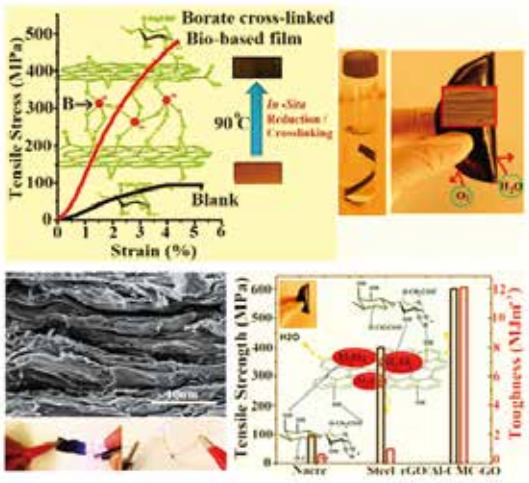
Bio-Based Hybrid Materials with Better Strength and Toughness

Bio-based materials are a kind of new materials synthesized by biological or chemical methods based on renewable resources. They are environmentally friendly, renewable and biodegradable, which make the frontier of materials science research.

A group led by JIANG Yijun from the Qingdao Institute of Bioenergy and Bioprocess Technology (QIBEBT) of the Chinese Academy of Sciences has achieved a series of progress in the design and preparation of bio-based hybrid materials. Their work has been published in *ACS Nano*.

The researchers developed the cellulose gel with the cellulose fibers, and prepared the cellulose-based sheet by in situ crosslinking. The wet strength of the material can reach 13 MPa, which overcomes the problem of low wet strength of traditional paper materials. At the same time, the dry strength of the material reaches 76 MPa and the toughness reaches 7 MJ/m^3, four times and 20 times of those of ordinary paper, which are even better than traditional polymer materials. More interestingly, cellulose gel network on the surface allows the material to have shape memory property and good barrier properties for water, oil, and gas. The material has a great potential to replace petrochemical-based polymer packaging materials.

Based on this study, the researchers further imitated the "brick and mud" structure of the nacre in nature, and prepared the bio-based artificial nacre using the in situ crosslinking and molecular interface technology. The mechanical strength of the composite material can reach 580MPa, equivalent to steel and four to seven times of the nacre. At the same time, its toughness is as high as 12.1 MJ/m^3, much higher than steel and nacre. The researchers also studied the barrier properties and electrical properties of the material. This "artificial nacre" composite material has potential applications in artificial muscle, tissue engineering, battery, super capacitor and aerospace.



Cellulose-based artificial nacre.

Their work was supported by the Qingdao Institute of Bioenergy and Bioprocess Technology, the Chinese Academy of Sciences, K.C. Wong Education Foundation, Shandong provincial government, and the National Natural Science Foundation of China.