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Tapping into the carbon mineralizing properties of bacteria to manufacture living wood

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Three materials – concrete, steel, and aluminum – are responsible for 23% of total global emissions, most of which come from the human-built environment. By contrast, as much as half of the dry weight of woody biomass is carbon that trees directly sequester from the atmosphere. Despite its promise, the use of wood in construction has a positive carbon footprint, even when the wood is sustainably sourced. Additionally, applications are limited by the material's flammability, low moisture resistance, and its tendency to deteriorate over time unless reinforced with concrete or other fillers. Yet, examples exist in nature (*e.g.*, black persimmon) of trees naturally reinforced with minerals produced by endosymbiotic bacteria. To mimic this natural process, we developed protocols for infiltrating carbon-mineralizing bacteria into wood species from sustainable sources. We demonstrate the uniform infiltration of the cells and *in situ* production of a polymeric carbon filler inside the wood pores while also greatly accelerating the natural process (days versus years). The resulting biomaterial exhibited a much higher carbon content by combining wood (~45% weight carbon) and mineralizing bacteria (>30% depending on the wood type). Notably, the tensile strength of the material increased approximately 2-fold, reaching levels suitable for expanded applications in construction. Using synthetic biology, we engineered bacterial strains with enhanced carbon capture capacity for sustained reductions of the carbon footprint of the biomaterial in constructed structures. The long-term viability of the mineralizing bacteria after infiltration ensures the production of a “living wood” material with superior mechanical properties and a beneficial climate footprint.