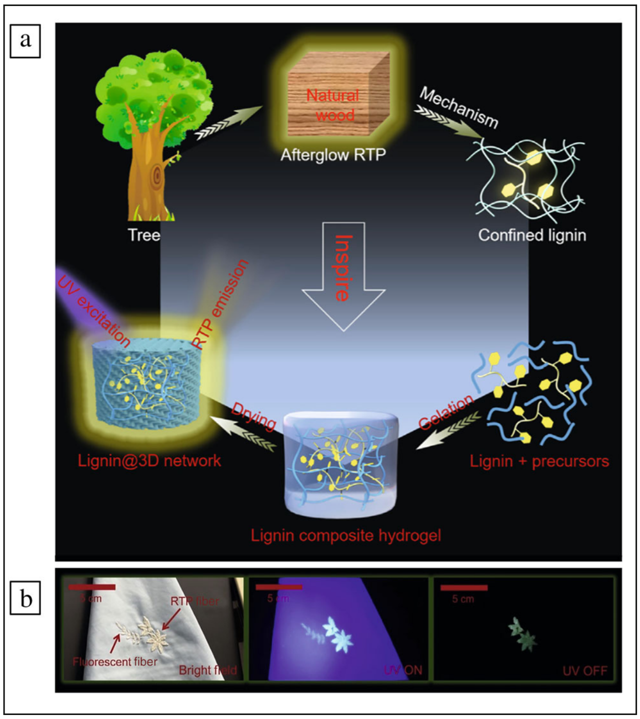
Wood phosphorescence inspires sustainable afterglow materials

Room-temperature phosphorescence (RTP) occurs when a material absorbs energy at a short wavelength and then slowly emits it as visible light as an "afterglow." It is a well-established phenomenon that, depending on the lifetime of the afterglow, can be employed in areas such as visual decorations, biological imaging, optical sensing, and information encryption. Organic afterglow RTP materials, using pure organic luminophores, have been produced, but they require complicated syntheses and do not degrade, which causes environmental issues. Zhijun Chen from Northeast Forestry University (China), Tony D. James of the University of Bath (UK), and their colleagues have discovered that basswood, a North American linden tree, naturally shows surprising afterglow RTP emission.



(a) Sustainable afterglow materials from lignin inspired by the room-temperature phosphorescence (RTP) of wood. (b) Digital images of needlework in bright field, under UV irradiation, and after the UV lamp is off. Credit: *Cell Reports Physical Science*.

As reported in a recent issue of *Cell Reports Physical Science* (https://doi.org/10.1016/j.xcrp.2021.100542), the researchers found that lignin is the luminophore in natural wood. The hydrogen bonding interaction between lignin and cellulose/hemicellulose promotes the afterglow RTP emission.

Mimicking the basswood matrix, the research team confined lignin within a three-dimensional (3D) polymer network, which allows glow visibility for one second (see **Figure a**). RTP emission of these materials could be tuned by adjusting the cavity size in the network and varying the polymer drying temperature or the cross-linking density. These alterations change the phosphorescence duration.

The researchers discovered that strong hydrogen bonding and non-bonding interactions between lignin and the 3D poly(acrylic acid) (PAA) matrix stabilize the triple state and result in strong afterglow RTP emission. That means that when the lignin is confined inside a polymer, more energy is emitted as light and the stronger the afterglow.

The researchers prepared fibers with strong afterglow RTP by coating cotton fibers with the lignin-based RTP materials, to illustrate potential applications of these sustainable materials. The fibers were then used to prepare luminescent textiles (see **Figure b**).

According to the article, these afterglow materials will make contributions to a more sustainable world due to the use of a natural lignin material. The researchers proposed that confinement of lignin within crystal matrices should be explored as a potential strategy for improving the RTP lifetime of lignin materials in the future. Also, the use of lignin—which is a naturally occurring polymer—adds value to this discovery.

Joan Stephanie Torres-Rodríguez