

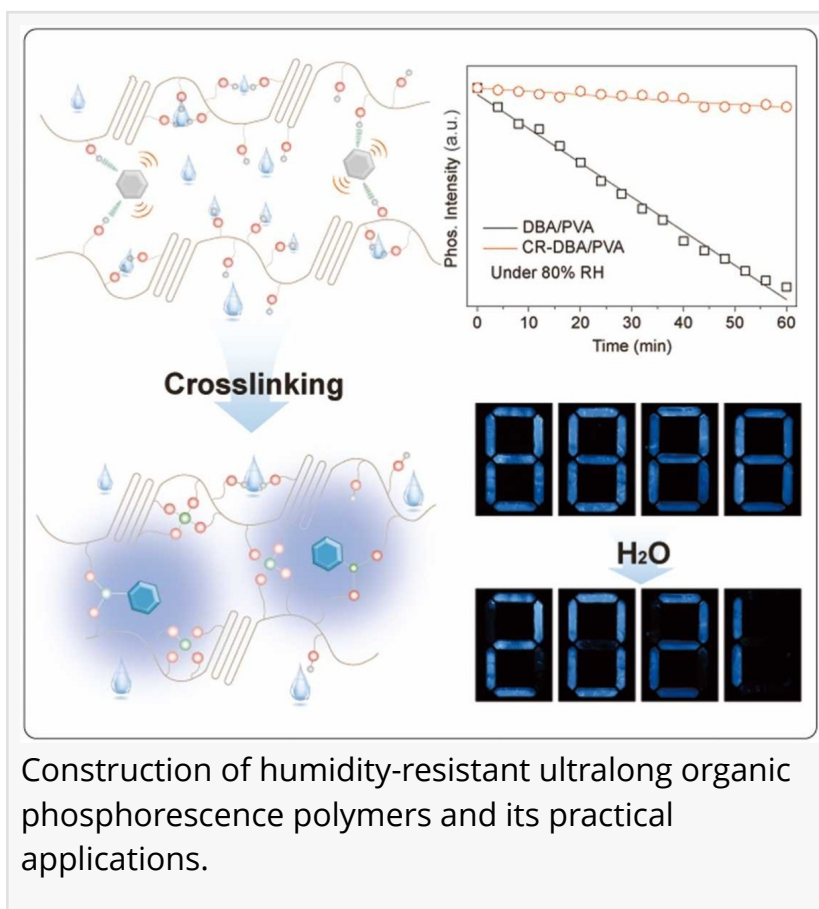
Humidity-resistant phosphorescent films achieved through crosslinking reaction

GA, UNITED STATES, June 23, 2025 /EINPresswire.com/ -- Researchers have developed a humidity-resistant phosphorescent material using a simple and effective strategy of multi-component crosslinking in polyvinyl alcohol (PVA) films. The innovation enables ultralong phosphorescence (3.18 seconds) under high humidity (80% RH), enabling applications in anti-counterfeiting, data encryption, and wearable electronics.

Phosphorescent materials exhibit long-lived emissions even after the excitation source is removed, a property that has generated considerable attention in recent years. Polymer-based RTP materials have shown potential for applications in wearable electronics, owing to the flexibility of polymer matrices and their unique phosphorescence properties. In a study published in the KeAi journal *Wearable Electronics*, a group of researchers from China have developed polymer films that exhibit long-lasting phosphorescent emission.

"The films maintain their colorful afterglow when exposed to moisture for several hours," shares first author of the study, Zhicheng Song. "The unique combination of adjustable phosphorescence, flexibility, transparency and lightness of polymer-based phosphorescent materials makes them especially suitable for applications in wearable electronics, including flexible displays, lighting, health monitoring and security tagging."

The doping strategy of embedding chromophores into a polymer matrix with rich hydrogen bonding like PVA has proven particularly effective. Nonetheless, moisture can severely disrupt the intermolecular hydrogen bonding between the chromophores and the PVA matrix,



promoting nonradiative decay and oxygen quenching, and ultimately leading to the quenching the phosphorescence.

“Under alkaline catalytic conditions ($\text{NH}_3 \cdot \text{H}_2\text{O}$), both chromophores and boric acid (H_3BO_3) form cross-links with hydroxyl groups in the PVA polymer chains,” adds Song. “This simple and effective multi-component crosslinking can construct covalent networks that shield chromophores from water while suppressing nonradiative decay.”

The films retained excellent optical clarity even at high crosslinking densities, which is crucial for diverse practical applications in many fields. “They demonstrated applications in anti-counterfeiting labels. When sprayed with water, the uncrosslinked parts of the labels immediately darkened while crosslinked parts (“2021 UOP”) remained visibly after glowing for more than 20 seconds after UV removal,” says Song. “Furthermore, long-persistent luminescence in various colors can be achieved by employing various chromophores with boric acid substituents.”

This study presents a simple, environmentally friendly method for producing humidity-resistant phosphorescent polymers with robust and stable phosphorescent properties, paving the way for their application in wearable electronics.

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