Chemists design organic molecules that glow persistently at room temperature

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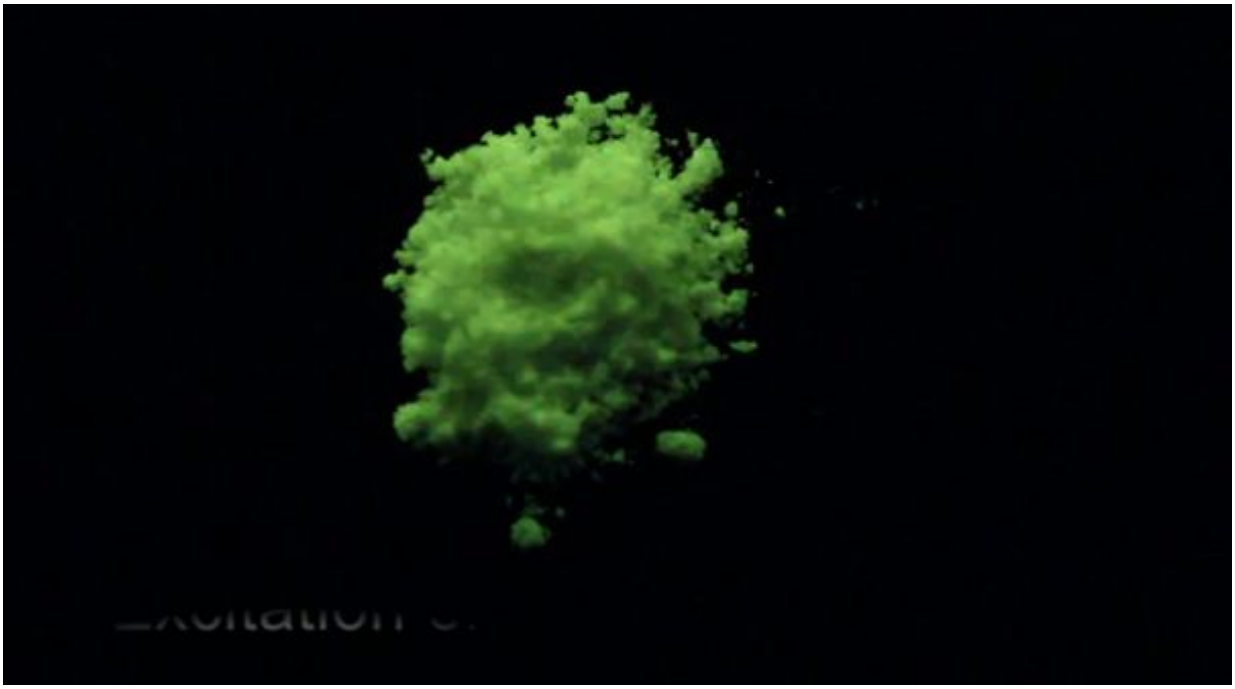

LEDs have inspired a new generation of electronics, but there is still work ahead if we want luminescent materials to consume less energy and have longer lifespans. Certain inorganic metals seem promising, but they are rare, expensive to process, and potentially toxic. In *Chem* on October 13, researchers in China present an alternative: a group of metal-free phosphorescent molecules that efficiently and persistently glow different

colors at room temperature and are potentially three times more efficient than a fluorescent organic LED.

Phosphorescence from organic compounds has typically been observed at extremely low temperatures and in the absence of oxygen, which limits their scope for practical applications. Room-temperature phosphorescence (RTP) has been more of a challenge, given that oxygen and physical vibrations interfere with the ability of organic phosphorescent molecules to emit light.

"Organic RTP systems are desirable, thanks to their wider availability and better tailorability, but are challenging to develop," says senior author Ben Zhong Tang, a chemist at the Hong Kong University of Science & Technology, and the South China University of Technology. "In this paper, we report pure organic RTP molecules with high efficiencies and long lifetimes that will help promote basic study and practical applications of RTP processes."

Tang, Weijun Zhao, and Zikai He, graduate students at the Hong Kong University of Science & Technology, and colleagues overcame the challenge by modeling how organic RTP systems behave. On the basis of this information, they designed and synthesized five carbonyl-containing aromatic molecules that stay excited and emit light for up to 230 milliseconds. The molecules could also be tuned to glow blue to orange-red. Other groups looking at the problem had focused more on blocking the phosphors' nonradiative decays.

The researchers hope that these engineered phosphors can be continually tweaked to meet the requirements for sensors and light-sensitive switches. "Based on our model or structural design principle, we will try to develop RTP systems with lifetime up to seconds and efficiency up to unity (100%)," Tang says. "In particular, we will work on the developments of RTP molecules and polymers with potential of finding

high-tech applications in bioimaging, optical recording, anti-counterfeiting, and afterglow organic LEDs."

More information: *Chem*, Zhao and He et al.: "Rational Molecular Design for Achieving Persistent and Efficient Pure Organic Room-Temperature Phosphorescence" www.cell.com/chem/fulltext/S2451-9294(16)30112-7 , dx.doi.org/10.1016/j.chempr.2016.08.010

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