Naked-eye detection of solvent vapor

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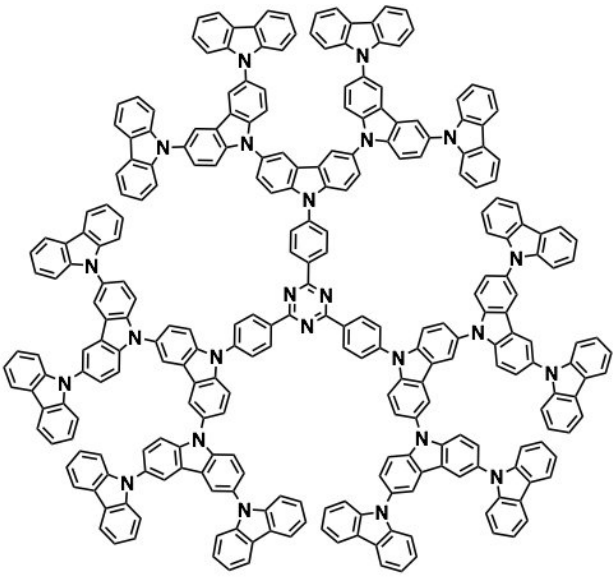

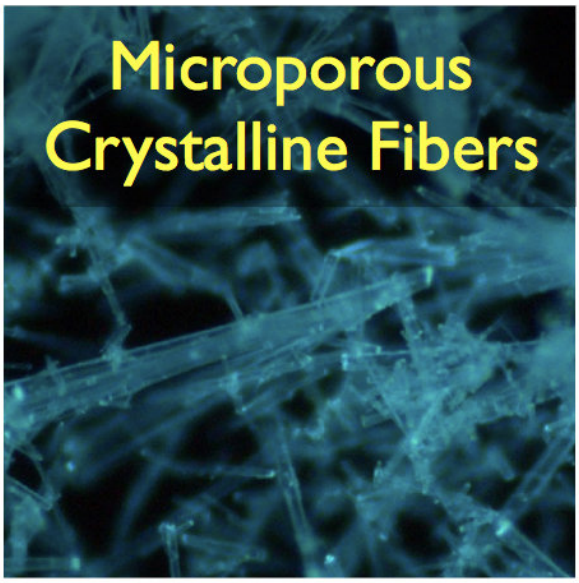

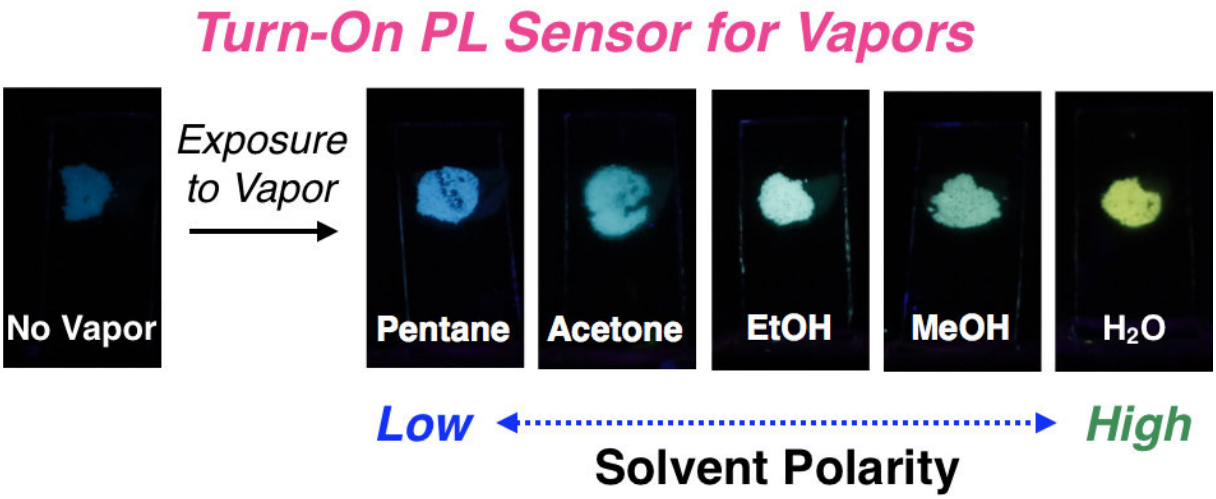

Credit: University of Tsukuba

Sensors are important for detecting contaminants and monitoring environmental conditions. Fluorescent sensors can reveal the presence of a contaminant according to the change of the intensity and/or wavelength of light that they emit. In particular, fluorescent sensors that display changes in emission color are attractive because such changes may be readily observed with the naked eye, making them easy to use.

A research team led by the University of Tsukuba has recently developed an effective fluorescent sensor for solvent vapor. Their sensor is based on a branched molecule called a dendrimer. The dendrimer is composed of an electron-accepting core attached to electron-donating branches. Under certain conditions, the dendrimer self-assembled into fibers that formed a crystalline framework containing numerous pores, which aided adsorption of solvent molecules.

"Slow diffusion of methanol or acetonitrile into chloroform solutions of the dendrimer yielded crystalline microfibers with high porosity," states Sae Nakajima. "Under other conditions, we obtained amorphous microspheres of the dendrimer that lack pores."

The research group investigated the crystal structure of the dendrimer by diffraction techniques, finding that the pore volume of the microfiber structure was over 70% of the total crystal volume. The high pore volume of the crystalline dendrimer microfibers greatly increased their gas adsorption capacity over that of the spheres formed under other conditions.

Films of the crystalline dendrimer displayed favorable emission behavior for use in solvent sensing. When the films were exposed to solvent vapor, their emission intensity increased considerably and their emission color quickly changed (within two seconds), reflecting the solvent polarity. This means that a single film could be used to detect numerous types of solvents. For example, a film appeared blue in a fluorescence

microscopy image before solvent exposure and became yellow after introduction of water vapor or green after methanol addition. The film returned to its original color when the solvent vapor was removed, allowing it to be reused.

"Dendrimers typically possess dense amorphous structures. The porous crystalline structure formed by our dendrimer under specific conditions increased its adsorption capacity and sensing ability, revealing the importance of crystalline structure in fluorescent sensing by dendrimers," says Yohei Yamamoto.

This work demonstrates that the visible sensing of solvent vapor can be realized using crystalline dendrimers with porous structures. Such dendrimers show promise for use in discrimination of gases and organic materials, making them attractive for environmental sensing applications.

More information: Sae Nakajima et al. A fluorescent microporous crystalline dendrimer discriminates vapour molecules, *Chemical Communications* (2018). DOI: 10.1039/C7CC09342J

Provided by University of Tsukuba