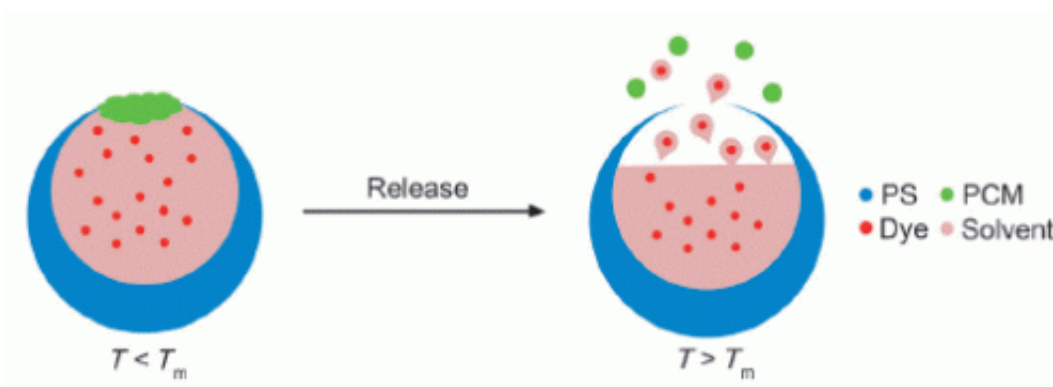


# Melting corks allow for temperature-controlled release of drugs from microscale vessels

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(Phys.org) —Sustained-release formulations that release drugs over longer periods of time are not the final step in the evolution of "intelligent" drug delivery systems. Modern pharmaceuticals are being designed to be released only in a specific, diseased organ; on cues from our circadian rhythm; or under specific physiological conditions. In the journal *Angewandte Chemie*, a team of American and Korean researchers has now introduced "microbottles" with "corks" that release their contents only when the temperature rises above a defined level.

Our [circadian rhythms](#) can cause our reaction to a drug to vary with time. Certain conditions and symptoms can also fluctuate with our

circadian rhythm. Some pharmaceuticals, such as [beta blockers](#), [chemotherapy drugs](#), and cortisone treatments thus come with recommendations for timing doses. The "intelligent" control drug release based on changing physiological conditions is an extension of these ideas.

Temperature in particular could be a useful regulator for such systems. Our body temperature varies throughout the day and in response to certain physiological states or phases, like disease. An "intelligent" blood pressure reducing drug could be released when body temperature and blood pressure rise due to stress. Inflammation usually causes the temperature of the affected area to rise, so a drug could be directed only to these hot areas. Alternatively, a diseased area of the body, such as a tumor, could be locally warmed to release chemotherapy drugs on the spot, causing fewer side effects.

Previous types of temperature-controlled microcontainers suffered from a slow loading process, low cargo capacity, or premature release of the drug. Younan Xia and a team at the Georgia Institute of Technology, Emory University in Atlanta (USA), and Yonsei University in Seoul (Korea) have now developed a new variety of corked "microbottle" for drugs. The cork melts at a defined temperature and releases the bottle's contents.

To produce their capsules, the researchers embedded the bottom half of some polystyrene spheres in a thin polymer film and soaked them with a mixture of toluene and water. Because toluene and water do not mix well, the toluene diffused into the spheres. The spheres were then flash-frozen and freeze-dried. The toluene evaporated, exiting through the tops of the spheres, leaving behind an opening and a cavity. Now the little bottles can quickly and easily be filled.

To cork the bottles, the researchers applied a film of the cork material to

a support and pressed it onto the support holding the vessels. Ethanol vapors cause the cork material to flow together around the vessels, hermetically sealing them. By changing the ratio of the materials used in the corks, tetradecanol and lauric acid, the melting points of the corks can be adjusted into a biologically useful range.

**More information:** Younan Xia, Microscale Polymer Bottles Corked with a Phase-Change Material for Temperature-Controlled Release, *Angewandte Chemie International Edition*, [dx.doi.org/10.1002/anie.201305006](https://doi.org/10.1002/anie.201305006)

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