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Sensing ammonia using dry waters containing cupric chloride solution

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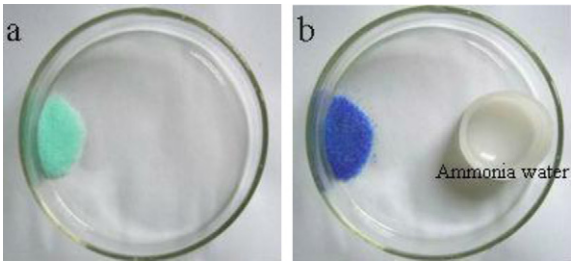
HIGHLIGHTS

- Dry waters containing cupric solution were used as a detector for ammonia.
- With the decrease of the diameter of the dry waters, the dry waters became more sensitive to ammonia.
- With the decrease of the concentration of cupric chloride solution, the dry waters became more sensitive to ammonia.

GRAPHICAL ABSTRACT

Dry waters containing cupric chloride solution were used as a detector for ammonia.



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ABSTRACT

Dry waters with cupric chloride solution–silica particles core–shell structures were prepared by a mixing method and were used as a detector for ammonia gas. The microscopy results showed that the dry waters were spherical and had an average diameter of 260 μm. When the dry waters was exposed to ammonia gas, their color were changed from green-blue to deep blue due to the generation of tetraamminediauacopper(II) complex ions. With the decrease of the diameter of the dry waters or the decrease of the concentration of cupric chloride solution, the dry waters became more sensitive to ammonia gas.

1. Introduction

Liquid marbles, which are droplets coated with a hydrophobic powder, have attracted significant attention of researchers after the pioneering work of Aussillous and Quéré [1–10]. Hydrophobic particles of regular or irregular shapes have been used to prepare liquid marbles by rolling liquid drops over a particle bed. The shells of liquid marbles consisted of multilayers of hydrophobic particles and were porous [7,11], and provided a channel for mass transfer between the outside material and the liquid core. Recently, Tian et al. used liquid marbles as colorimetric and fluorescent detectors for ammonia and hydrochloride gases [11]. They found liquid marbles offers flexibility to achieve different designs for chemical sensing. However, as the liquid marbles prepared by the rolling method have a diameter of millimeter size, their specific surface area was relatively small. In addition, only single liquid marble was prepared for a batch by the rolling method [1–4], which would be a limitation for their practical applications.

First described in 1969 in a patent published by Degussa, dry waters may be easily prepared at an industrial scale by high shear mixing of superhydrophobic silica and water [12]. Dry water is a solidified form of water, where water droplets are surrounded by a silica coating. Dry water actually consists of more than 80 percent liquid water, but the silica coating prevents the water droplets from combining and turning back into a liquid. As an analog of liquid marble, dry water has a diameter of micrometer grade, which is much smaller than that of liquid marble [13–15]. Therefore, dry water has much larger specific surface area than liquid marble, which will be

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