Humidity Control in a Closed System utilizing Conducting Polymers

産総研 [1], OPERANDO-OIL[2], JST-PRESTO[3] 産総研 [1] ○衛　慶碩 [1,2,3], 向田 雅一 [1,2], 丁 武孝 [1], 石田 敬雄 [1,2]

AIST[1], OPERANDO-OIL[2], JST-PRESTO[3] Qingshuo Wei[1,2,3], Masakazu Mukaida[1,2], Wuxiao Ding[1] and Takao Ishida[1,2]

E-mail: qingshuo.wei@aist.go.jp

The control of relative humidity (RH) levels in enclosed spaces is not only important for laboratory-scale experiments in physics, chemistry, and biology but also in fields of study such as agriculture and food storage. Two methods are predominantly used to precisely control RH levels in closed system environments. One method is the gas flow method in which a dry gas that was passed through a desiccant is mixed with a gas that has been passed through water. By controlling the ratio between the two gases, the humidity can be controlled. One of the advantages of this method is that an equilibrium can be quickly established (*i.e.*, within several minutes), and the changes in the humidity can be continuous. However, this system is relatively complicated and bulky. Aside from the gas supply, a number of different moving parts and valves are required for the construction of the equipment required for this method. The second method predominantly used to precisely control humidity involves the use of saturated salt solutions such as lithium chloride or magnesium chloride. This method is highly accurate and relatively simple to perform, because the concentration of a saturated solution is fixed and the vapor pressure can be precisely determined for different temperatures. However, this method can lead to salt contaminating a closed system, which is detrimental for laboratory-scale experiments.

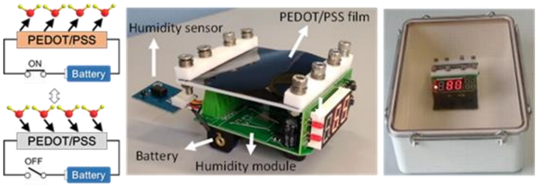

Figure 1. Schematic diagram and image of the humidity control unit using a humidity switch on a printed circuit board.

Furthermore, the humidity value that can be obtained using this method are discontinuous, as the salt solution has to be changed so that different humidity values can be obtained. This can result in it taking several hours for an equilibrium to be achieved.

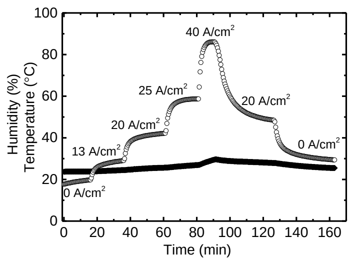

Figure 2. The humidity and temperature (closed square) in the closed system as a function of time for different current flows.

In this study, we demonstrate that conducting polymers could be ideal materials for continuously managing the humidity in a wide range of enclosed spaces. We demonstrate a simple battery-driven humidity control unit to manage the humidity in a closed environment (Figure 1 and 2) and studied humidity-responsive nanocapsules using Zn-coordinated lipid nanovesicles. This study not only promises new applications for conducting polymers but also provides an easy approach for fabricating chambers with a controlled environment, which are often used by physicists, chemists, and biologists.