

An Ionic Actuator Based On Chitosan, Ionic Liquid and Multiwalled Carbon Nanotube Electrode

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Extended Abstract

Ionic electroactive polymers have attracted great attention in recent decades for their quick and soft actuation by low voltage similar to natural muscle, large displacement, and light weight (Jo et al., 2013; Kosidli et al., 2013; Torop et al., 2011). Typically, IPMC is composed of one ionic electrolyte membrane sandwiched between two metallic electrode layers such as gold, platinum, and palladium (Kim, Shahinpoor 2003; Shahinpoor, Kim; 2000; Kim et al., 2011). The crack generation on a metallic electrode and the water electrolysis decrease the hydration level of the IPMC actuator, resulting in energy consumption and reducing the actuator performance (Lu et al., 2008; Park et al., 2010). Therefore, the flexible electrode with good electrical properties and ionic liquid as the electrolyte are significant for the actuator. The multiwalled carbon nanotube (MWCNT) paper with high conductivity and capacitive energy storage can decrease the surface resistance, increase current density, and greatly improve the performance of the ionic actuator.

First, the CS/BMImBF₄/glycerol membrane can be prepared by solution casting method. CS (100mg) was added to 2% acetic acid solution (5 ml). The mixture was stirred at 60 °C for 30 min to form a homogenous solution. Then, the glycerol (0.8 g) and BMIBF₄ (100 mg) were added to the above CS solution and stirred at 60 °C for 30 min. The obtained suspensions were cast in a PDMS container (Length × Width × Height, 50 mm × 30 mm × 40 mm) and placed in an oven at 60 °C for 4 h to obtain the electrolyte membrane. Second, CS powder (45 mg) was added to 2% acetic acid solution (10 mL) and the mixture stirred at 60 °C for 30 min to form a homogenous solution. The MWCNTs (80 mg) and BMIBF₄ (100 mg) were added to the above solution and sonicated for 30 min in an ice-water bath. The chitosan/MWCNT/BMIBF₄ solution was evaporated in PDMS container at 60 °C for 12 h to obtain the MWCNT electrode film. Third, a piece of CS/ BMIBF₄/MWCNTs electrode was carefully stuck on each side of the obtained half-dried membrane. The three-layered ionic actuator was pressed at 70 °C with 10 N (90 s) in first pressing process then with 270 N (90 s) in second pressing process using hot-pressing method.

The newly ionic actuator composed of an ionic electrolyte layer sandwiched by two chitosan/ionic liquid/MWCNTs electrode layers was successfully fabricated.

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