# ELECTROCHROMIC DEVICES, METHODS OF MANUFACTURING AND OPERATION THEREOF

## TECHNICAL FIELD

[0001] The present invention relates to electrochromic materials, devices, methods of their manufacturing and methods of their operation.

## BACKGROUND

[0002] Electrochromism is the physical phenomenon found in certain compounds, compositions or assemblies which can reversibly change optical properties such as color or light transmittance due to electric current arising with an application of a voltage called a control voltage. Electrochromism provides the basis for operation of various electrochromic devices, such as smart glass in the form of windows, mirrors and displays. Various types of optical materials and structures can be used to construct compositions with electrochromic properties, with the specific structures being dependent on the specific purpose of the electrochromic device.

[0003] A variety of patents and patent applications disclose electrochromic materials and devices. Such patents and patent applications include, for example, US 2015/0353819 describes electrochromic compositions and devices; RU2642558C1 describes manufacturing and operation of organic electrochromic devices manufactured by UV-curing of polymer matrices containing organic active electrochromic materials; US 6262832, US 6433914, US 6445486, US 6710906, US 7031043 and US 8294974 disclose various electrochromic materials and devices. A review article discloses all-in-one gel-based electrochromic devices. See Alesanco et al., Materials 2018, 11, 414, pp. 1-27.

[0004] However, there is a continuing need for electrochromic materials, devices, methods of their manufacturing and methods of their operation.

## SUMMARY OF THE DISCLOSURE

[0004a] In an aspect, the present disclosure refers to an electrochromic device (100) comprising:
a first electrode (126a), second electrode (126b) and an electrochromic composition including one or more electrochromic materials;
wherein at least one of the one or more electrochromic materials undergoes electron exchange only at either the first electrode or at the second electrode,
wherein the electrochromic device (100) further comprises a selectively permeable membrane (270) within the electrochromic composition and disposed between the first (126a) and second electrode (126b), wherein the membrane (270) has a center portion and a peripheral portion, characterized in that the center portion has a permeability higher than that of the peripheral portion.

[0004b] In an example, the present disclosure refers to an electrochromic device comprising: a first electrode, second electrode and an electrochromic composition including one or more electrochromic materials; wherein at least one of the one or more electrochromic materials undergoes electron exchange only at either the first electrode or at the second electrode.

[0005] Examples of the present disclosure include electrochromic devices and components thereof and systems and methods for controlling electrochromic devices. Additional examples of the present disclosure include electrochromic materials, electrochromic compositions and electrochromic layers. In certain examples of the present disclosure, the electrochromic composition and layers can be in the form of a gel. The present disclosure also provides exemplary methods to fabricate electrochromic devices and components thereof, electrochromic compositions, layers and gels.

[0006] Additional advantages of the present invention will become readily apparent to those skilled in this art from the following detailed description, wherein only the preferred embodiment of the invention is shown and described, simply by way of illustration of the best mode contemplated of carrying out the