Supporting Information for

Smart Polydiacetylene Nanowire Paper with Tunable Colorimetric Responses

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For a typical synthesis procedure, 0.691 g of purified colorless 5,7-octadecadiynoic acid (ODDA, GFS Chemicals) monomer was dissolved in a 100 mL 0.2 M NaOH aqueous solution to achieve a clear homogeneous solution after 10 min of vigorous stirring. The solution was transferred into a large glass petridish with a diameter of ~11 cm. To prevent ODDA polymerization from light exposure, the petridish was covered by an aluminum foil during the self-assembly process. After 12 h of storing at room temperature (RT), the white gel was transferred to a Buchner funnel with a diameter of ~11 cm, and filtrated by vacuum filtration. The ODDNa nanofiber paper was peeled from filter-paper (Whatman), then covered by aluminum foil and dried at room temperature. The nanofiber paper was changed to ODDA by reacting with hydrochloric vapor after stored in a 3-L glass desiccator with 10 ml concentrated hydrochloric acid for 12h.

The red ODDNa nanofiber paper and blue ODDA paper were all formed via topochemical 1,4-addition polymerization of the diacetylenic units by exposure to 256 UV radiation from a ultraviolet lamp for 10 min.

In the metal ion senor experiments, the white ODDNA paper was cutted into small pieces (1 cm x 1 cm) and emerged into the different metal-salt solution (0.1M) for 2 mins, and then exposed to 256 UV radiation for 10 mins. These papers changed to different colors depending on the type of metal ions.

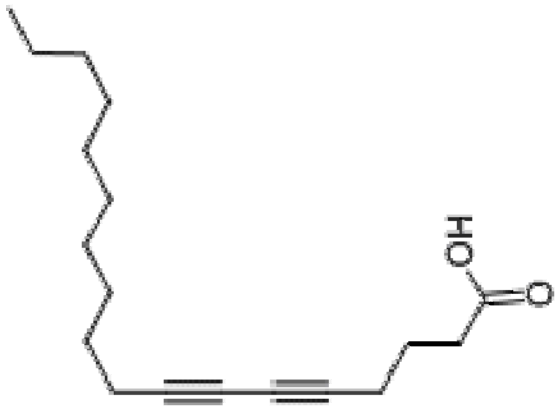

Figure S1. 5,7-octadecadiynoic acid molecular formula.

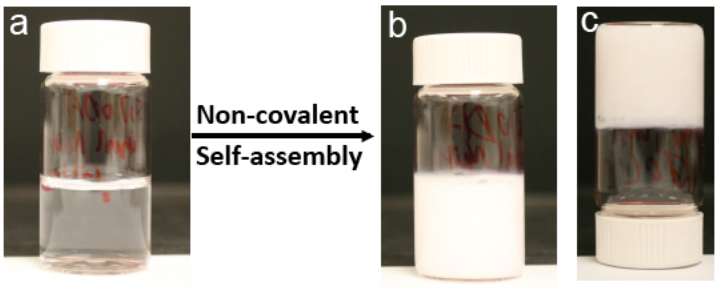

Figure S2. Formation of ODDNa gel from ODDNa sol through non-covalent self-assembly (π-π and hydrogen bonding). (a) 0.069 g ODDA was dissolved in 0.2 M NaOH aqueous solution to form a clear sol. (b) After 12-48 hours, a ODDNa gel was formed. (c) Vial in (b) was upside down to show the formation of a solid gel.

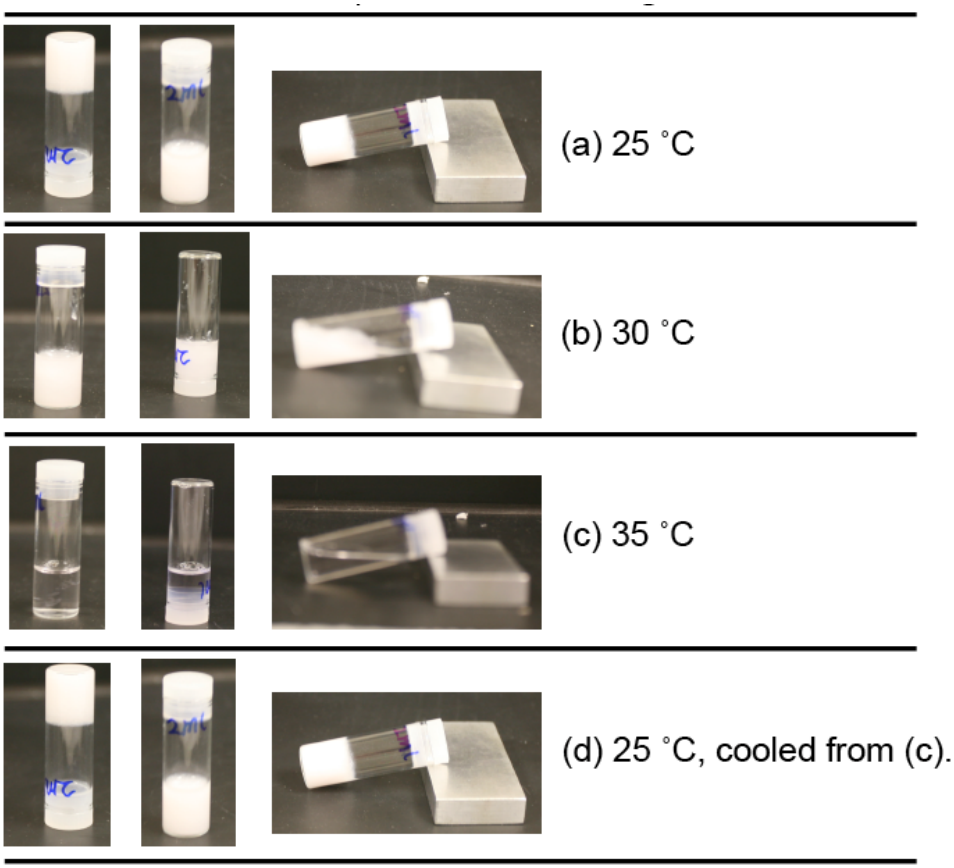

Figure S3. Optical pictures of the ODDNa gels at different temperatures. These results show that these gels are temperature sensitive. Temperature increasing from 25 ˚ to 35 ˚C essentially interrupted the weak non-covalent interactions (π-π, hydrogen bonding) with ODDNa gels. Without these weak non-covalent interactions, the gels become clear solutions that self-assemble into gel networks again upon cooling down. All the gels were formed by adding 0.014g ODDA to 2 ml 0.2M NaOH following by storing at ambient conditions (25 ˚C) for 24 hours.

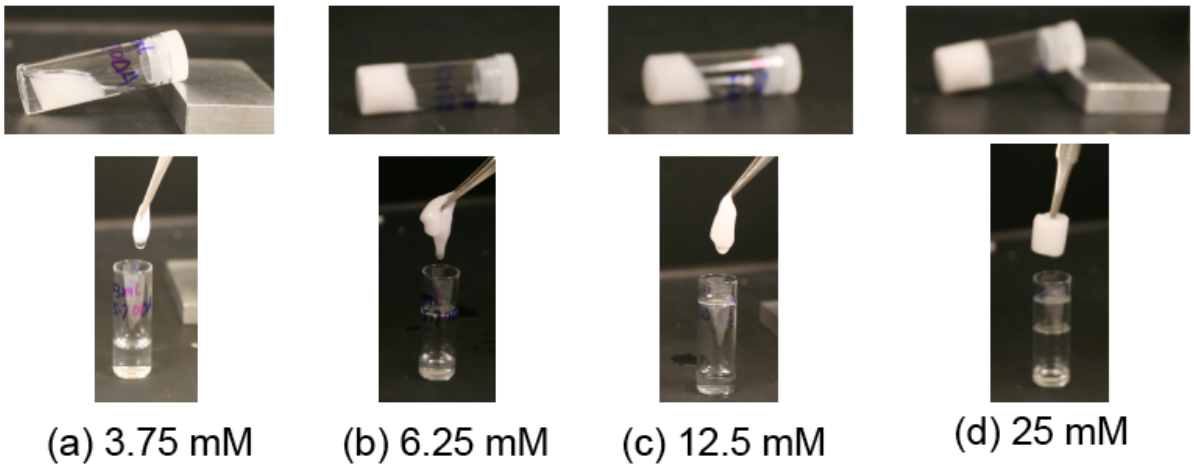

Figure S4. Optical pictures of the ODDNa gels formed at different ODDA concentrations while NaOH was kept constantly at 0.2 M in each solution. (a) 3.75 mM: some small amount of gels or pulps were formed. Large amount of water was left within the vial. (b) 6.25 mM: relatively large amount of gels were formed, but still with some water left within the vial. (c) 12.5 mM: similar to case (b). (d) 25 mM: gel was full formed. At this concentration, the gel can hold almost all water (ODDA (wt): water (wt) =6.9:1000). These results suggested that water is necessary within the gel network for hydrogen bonding to form a stable self-assembled gel network.

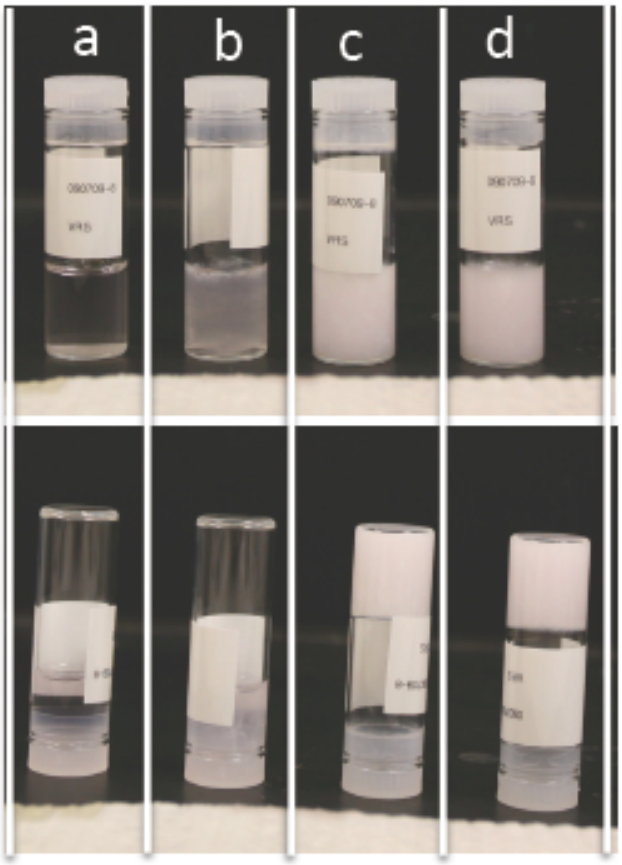

Figure S5. Optical pictures of the ODDA gels formed at different NaOH concentrations while ODDA was kept constantly at 25 mM in each case. (a) 0.07 M: clear sol with no gels formed. (b) 0.1 M: sol becomes opaque, but no apparent gels were formed. (c) 0.2 M: solid and firm gels were formed. (d) 0.3 M: solid and firm gels were formed. Vials were upside down to show the fluidic nature of the gels.

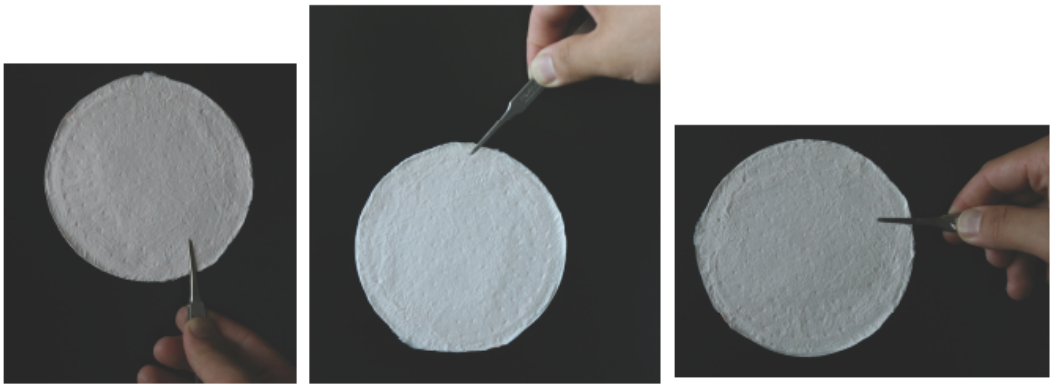

Figure S6. Optical pictures showing the nanowire paper can be handled freely. The size of the paper is 4 inch.

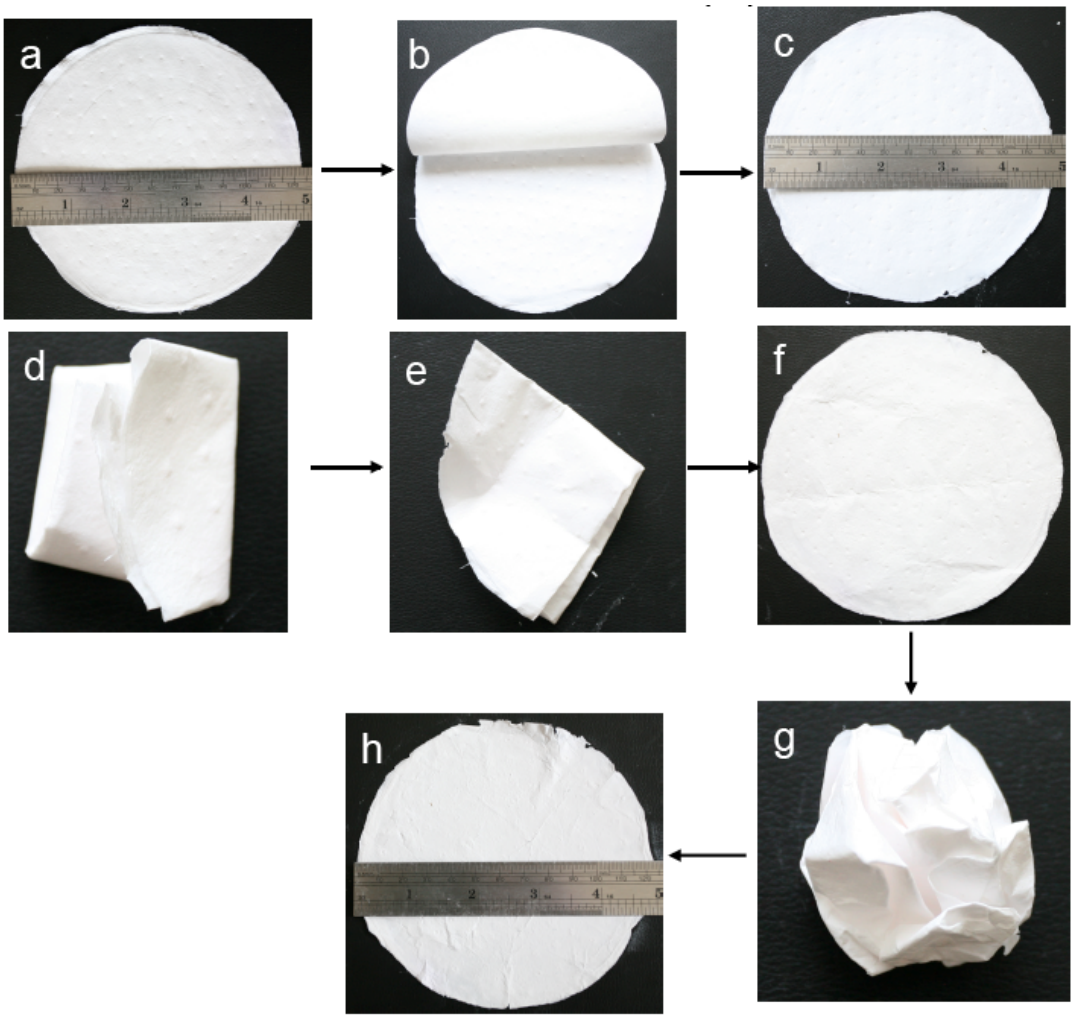

Figure S7. Optical pictures showing the nanowire paper can be freely folded in all directions and resumed back to flat paper.

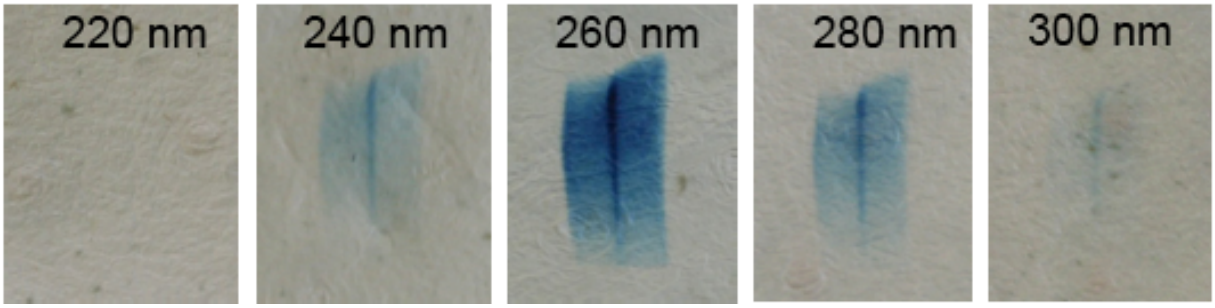

Figure S8. Optical picture of ODDA papers exposed under UV light with different wavelengths for 20 seconds.

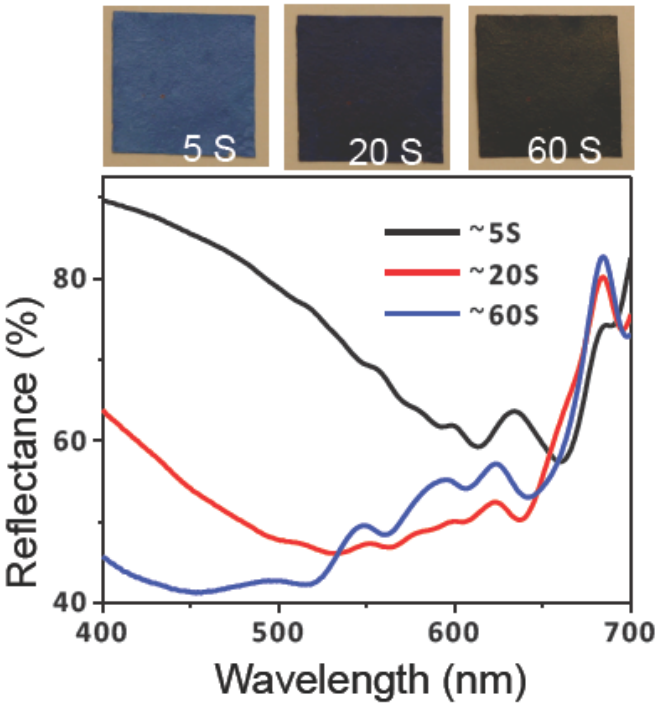

Figure S9. UV reflectance spectra of PODDA nanowire papers at different exposure time of 256 nm UV irradiation. Along increasing irradiation time, the UV spectra is blue shifted and remain upshifted after 20 seconds, which suggests the complete polymerization of ODDA paper.