Supporting Information for

Roll-to-Roll Redox-Welding and Embedding for Silver Nanowire Network Electrodes

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METHODS

Roll-to-roll redox-welding of AgNWs: The AgNW networks (Nanopyxis Co.) were formed by the Meyer rod coating method on plastic substrates (PI and PET) using 0.5 wt% AgNWs dispersed in isopropyl alcohol (PA). The average diameter and length of the AgNWs were 30 nm and 30 μm, respectively. The deposition densities for the AgNW network were controlled using different Meyer rods (#5, #7, #10, and #14). The as-coated AgNW films were sequentially immersed in the aqueous solution of HNO_3 (0.05 to 5 M) and $NaBH_4$ (0.005 to 0.05 M) for various times. The surfaces of the AgNW films were visualized by scanning electron microscopy (SEM, JSM-7600F, Jeol Ltd.). The sheet resistance and optical transmittance were measured by a four-point probe technique (Keithley 2182A and 6221) and a UV-vis spectrophotometer (Agilent 8453), respectively. In order to fabricate the single-wire junction of the AgNWs, the AgNW suspensions were diluted and deposited onto the Si wafer. The contact pads were defined by electron-beam lithography and 100-nm-thick Au electrodes were deposited by thermal evaporation. The *I-V* characteristics of both the wire and junction were measured using a Keithley 4200 probe system.

Roll-to roll embedding of AgNWs: A PI film coated with large-area redox-welded AgNWs was placed in a roll-to-roll equipment. A UV-curable prepolymer resin (NOA63, Norland) was then dropped using dispersers onto the AgNWs-PI film moving at a velocity of 1 cm s^{-1}. The bare PET film was laminated onto the UV-resin-coated AgNWs/PI film at a pressure of 0.6 MPa. The laminated film was transferred to a UV-exposure chamber (360 nm, 5000 mJ cm^{-2}) to cross-link the resin. The embedded AgNWs/PET film was then separated from the PI film.

Fabrication of OLEDs: Six organic materials required for the blue-emitting fluorescent OLED was deposited *via* a vacuum evaporator: 35-nm-thick 1,4,5,8,9,11-hexaazatriphenylene-hexacarbonitrile as the hole injection layer, 80-nm-thick *N,N'*-bis-(1-naphthyl)-*N,N'*-dipheny-1,1'-biphenyl-4,4'-diamine as the hole transport layer, 20-nm-thick 4,4',4''-Tri(*N*-carbazolyl)triphenylamine as the electron blocking layer, 20-nm-thick 2-methyl-9,10-di(2-naphthyl) anthracene and 5% 1,6-bis(*N*-phenyl-p-CN-phenylamino)-pyrenes (Pyrene-CN) as the host and dopant materials, respectively, for blue fluorescent emission, 40-nm-thick LG201 doped with 50% Liq as the electron transporting layer, and 1.5-nm-thick Liq as an electron injection layer. Finally, a 100-nm-thick aluminum layer was deposited thermally to form the cathode electrode. The emission area was 10 × 10 cm^2. The optoelectrical properties were measured by a Keithley 236 source meter and a Minlota CS2000 spectroradiometer.

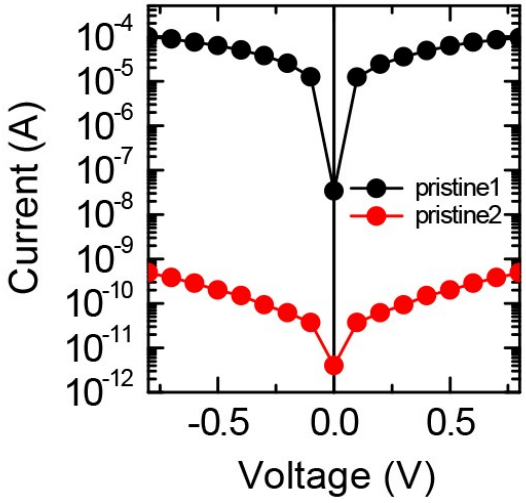

Figure S1. Current-voltage curves of the pristine AgNW junctions.

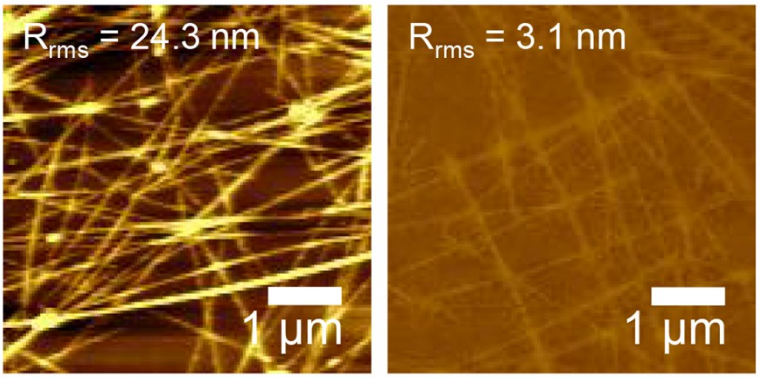

Figure S2. AFM images of the AgNWs films before and after embedding process.

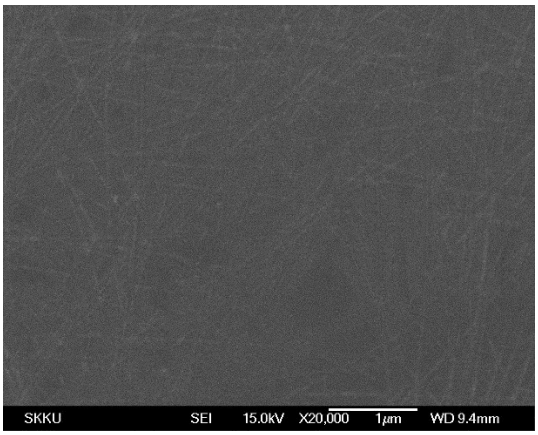

Figure S3. SEM image of the AgNWs embedded in UV-resin.

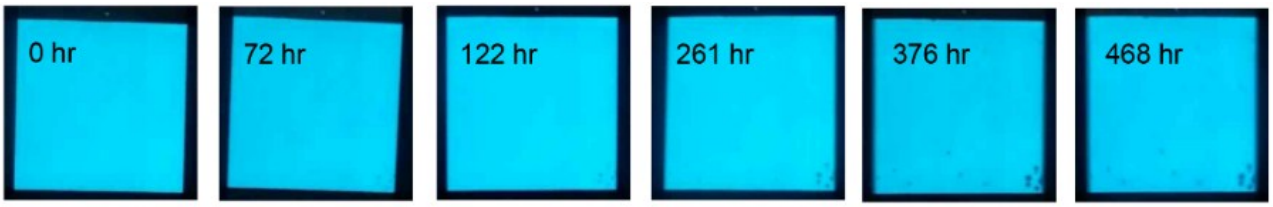

Figure S4. Environmental stability of the OLED devices based on the redox-welded AgNWs.

Table S1. Surface energies of UV-resin, PET, and PI.

	contact angle		γ^d (mJ/m^2)	γ^p (mJ/m^2)	γ (mJ/m^2)
	water	diiodomethane			
UV-resin	41.0°	48.5°	23.2	33.1	56.3
PET	44.0°	21.7°	35.9	22.9	58.9
PI	49.5°	42.0°	28.0	24.0	52.0

$$WA_{12} = 4\left(\frac{\gamma_1^d \gamma_2^d}{\gamma_1^d + \gamma_2^d} + \frac{\gamma_1^p \gamma_2^p}{\gamma_1^p + \gamma_2^p}\right)$$

$WA_{UV\text{-}resin/PET}$ = 110.5 mJ/m^2
$WA_{UV\text{-}resin/PI}$ = 106.4 mJ/m^2