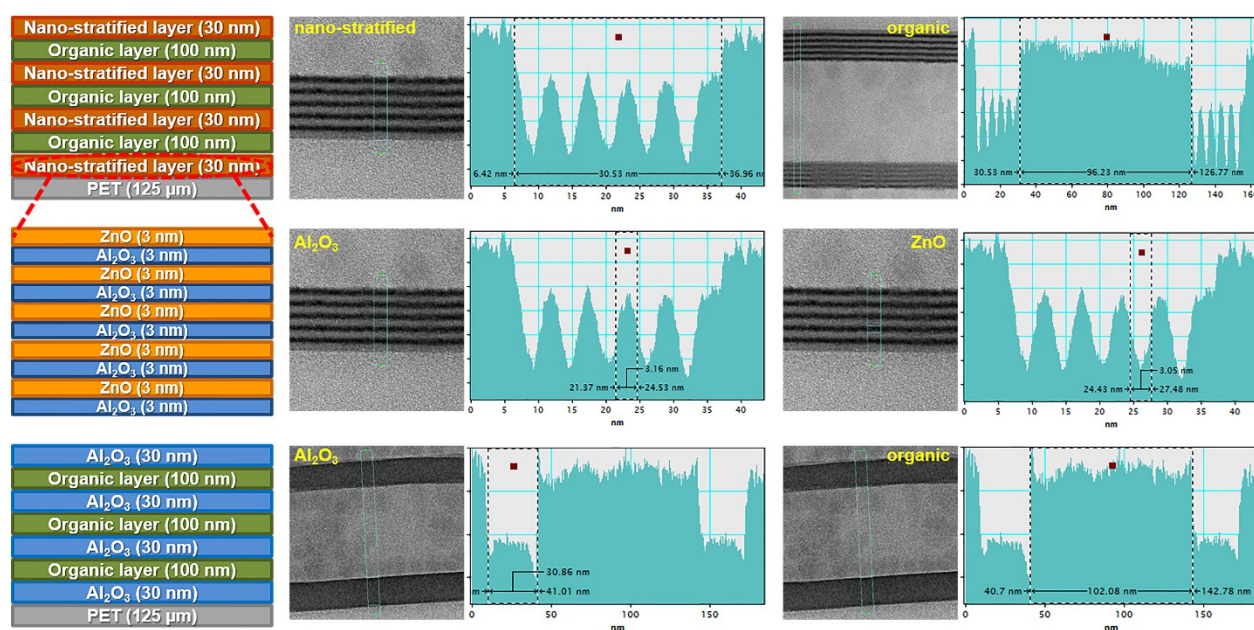


## Supporting Information

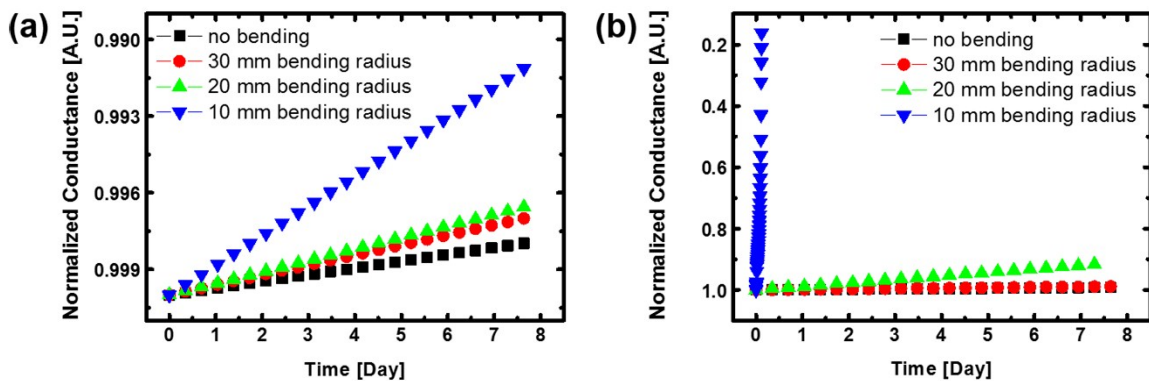
# Mechanically Enhanced Hybrid Nano-stratified Moisture Barrier with Defect Suppression Mechanism for Highly Reliable Flexible OLEDs

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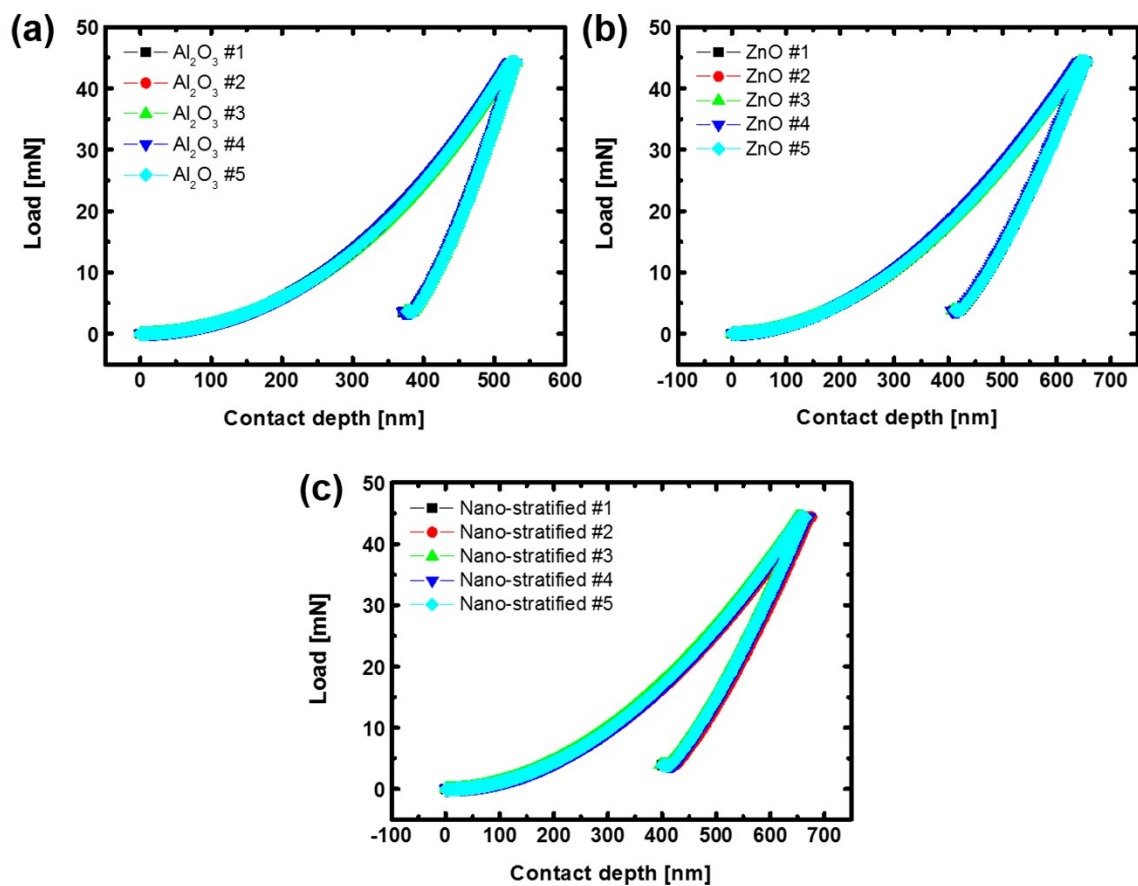
*Cheol Choi\**



**Figure S1.** Cross section TEM images of the nano-stratified barrier and multi-barrier using the Gatan Microscopy Suite<sup>®</sup> 3.



**Figure S2.** Normalized conductance vs. time graph during the electrical Ca test: (a) 3.5 dyads nano-stratified barrier with various bending radii, and (b) 3.5 dyads multi-barrier with various bending radii.



**Figure S3.** Nano-indentation results for various layers: (a) Al<sub>2</sub>O<sub>3</sub> layer, (b) ZnO layer, and (c) the nano-stratified structure.

**Table S1.** Physical properties of the Al<sub>2</sub>O<sub>3</sub>, ZnO and the nano-stratified structure

| <b>Al<sub>2</sub>O<sub>3</sub></b> | <b>Target Depth</b> | <b>Target Load</b> | <b>Ave. Hardness</b> | <b>Ave. Modulus</b> |
|------------------------------------|---------------------|--------------------|----------------------|---------------------|
| Test 1                             | 700 nm              | 45 mN              | 8.8 GPa              | 135.1 GPa           |
| Test 2                             | 700 nm              | 45 mN              | 8.1 GPa              | 133 GPa             |
| Test 3                             | 700 nm              | 45 mN              | 8.5 GPa              | 134.8 GPa           |
| Test 4                             | 700 nm              | 45 mN              | 8.4 GPa              | 133.3 GPa           |
| Test 5                             | 700 nm              | 45 mN              | 9.1 GPa              | 135.6 GPa           |
| Average                            | 700 nm              | 45 mN              | <b>8.58 GPa</b>      | <b>134.36 GPa</b>   |

| <b>ZnO</b> | <b>Target Depth</b> | <b>Target Load</b> | <b>Ave. Hardness</b> | <b>Ave. Modulus</b> |
|------------|---------------------|--------------------|----------------------|---------------------|
| Test 1     | 700 nm              | 45 mN              | 7.7 GPa              | 105.3 GPa           |
| Test 2     | 700 nm              | 45 mN              | 7.8 GPa              | 107 GPa             |
| Test 3     | 700 nm              | 45 mN              | 7.7 GPa              | 106.8 GPa           |
| Test 4     | 700 nm              | 45 mN              | 8 GPa                | 109.5 GPa           |
| Test 5     | 700 nm              | 45 mN              | 8 GPa                | 108.5 GPa           |
| Average    | 700 nm              | 45 mN              | <b>7.84 GPa</b>      | <b>107.42 GPa</b>   |

| <b>Nano-stratified</b> | <b>Target Depth</b> | <b>Target Load</b> | <b>Ave. Hardness</b> | <b>Ave. Modulus</b> |
|------------------------|---------------------|--------------------|----------------------|---------------------|
| Test 1                 | 700 nm              | 45 mN              | 4.5 GPa              | 61.5 GPa            |
| Test 2                 | 700 nm              | 45 mN              | 6.8 GPa              | 76.4 GPa            |
| Test 3                 | 700 nm              | 45 mN              | 6.1 GPa              | 72.5 GPa            |
| Test 4                 | 700 nm              | 45 mN              | 5.5 GPa              | 75.7 GPa            |
| Test 5                 | 700 nm              | 45 mN              | 6.4 GPa              | 73.9 GPa            |
| Average                | 700 nm              | 45 mN              | <b>5.86 GPa</b>      | <b>72 GPa</b>       |