Supporting Information

Microwave Assisted Calcination for Electrospun IGZO Nanofibers for High Performance Field-Effect-Transistors

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1. Temperature of microwave annealing

Figure S1 shows the schematic diagram of our microwave (MW) irradiation system. The MW irradiation system is equipped with an infra-red (IR) thermometer, and the IR thermometer shows the calibrated temperature. Therefore, the temperature of sample can be measured in real time while irradiating the microwave through the IR thermometer.

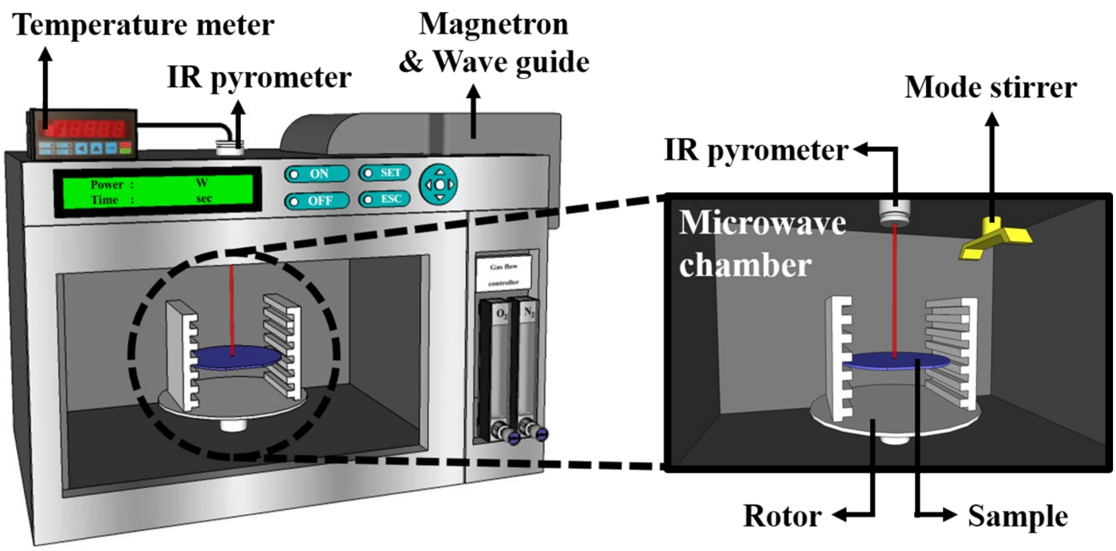

Figure S1. Schematic of microwave irradiation system with calibrated IR thermometer.

Figure S2a illustrates the temperature of an In-Ga-Zn-O (IGZO) nanofiber sample according to microwave power measured using the IR thermometer. IGZO nanofiber samples were prepared by electrospinning IGZO nanofibers on a p-Si/SiO_2 substrate. **Figure S2b** shows the temperature profile of the sample with respect to the microwave irradiation time. It can be seen that within 20 seconds the temperature is nearly saturated and then remains almost constant regardless of the irradiation time. The temperature of the IGZO nanofiber samples increased linearly with increasing microwave power, reaching approximately 530 °C at 1800 W, which is the highest temperature available in our microwave irradiation system.

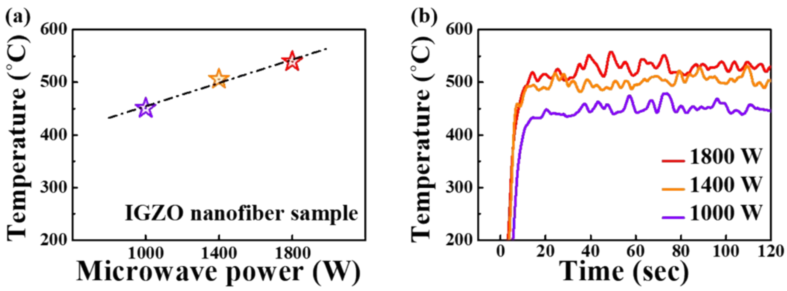

Figure S2. (a) Temperature of the electrospun IGZO nanofiber samples according to the microwave irradiation power measured by an IR thermometer. (b) Temperature profile of the sample with respect to the microwave irradiation time.

2. Electrical properties of IGZO nanofibers FETs

In this study, we compared conventional thermal annealing (CTA) using resistive heating furnace and microwave annealing (MWA) using MW irradiation system as calcination process for electrospun IGZO nanofibers. **Figure S3a, b** show transfer characteristic curves (I_D-V_G) of MWA calcined IGZO nanofiber field-effect-transistors (FETs) according to MW power, and CTA calcined IGZO nanofiber FETs according to CTA temperature, respectively. The post spun annealing (PSA) for these devices were performed by CTA at 600 °C for 30 minutes in O_2 ambient. As the MW power and CTA temperature respectively increase, the drain current of the IGZO nanofiber FETs increases, improving device performance. Therefore, MWA of 1800 W, the maximum power of our MW irradiation system, was applied in this study as an optimal calcination process condition, and the CTA of 600 ° C was applied to compare it.

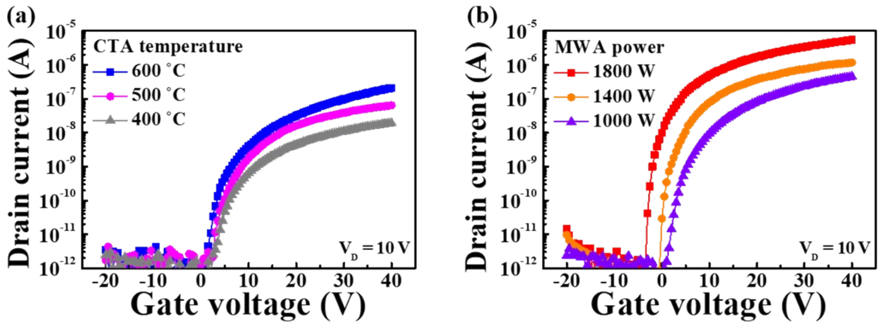

Figure S3. Transfer characteristic curves of IGZO nanofiber FETs according to (a) temperature of CTA and (b) power of MWA as calcination process.

Figure S4a shows the I_D-V_G curves of IGZO nanofibers FETs according to post spun annealing (PSA) temperature identified to establish optimized PSA conditions. The calcination process for these devices was performed by MWA at 1800 W for 2 minutes in air ambient, and PSA was performed by CTA for 30 minutes in O_2 ambient. As the temperature of the CTA increases, the drain current of the IGZO nanofibres FETs increases, improving device performance. Therefore, we determined the CTA of 600 °C as the optimal PSA condition and applied it to this study. In addition, In addition, to evaluate the difference according to the MWA ambient, the I_D-V_G curves of IGZO nanofiber FETs with air, O_2, and N_2 as MWA ambient were compared as shown in **Figure S4b**. The performances of the IGZO nanofibres FETs were poor in the N_2, but excellent in the O_2 and air. It is found that pure O_2 treatment can achieve the electrical properties of IGZO nanofibres FETs that are much better than pure N_2 treatment. On the other hand, air ambient is much better than pure N_2, and can obtain almost equivalent electrical properties as pure O_2. Therefore, we applied air ambient annealing for low cost processes.

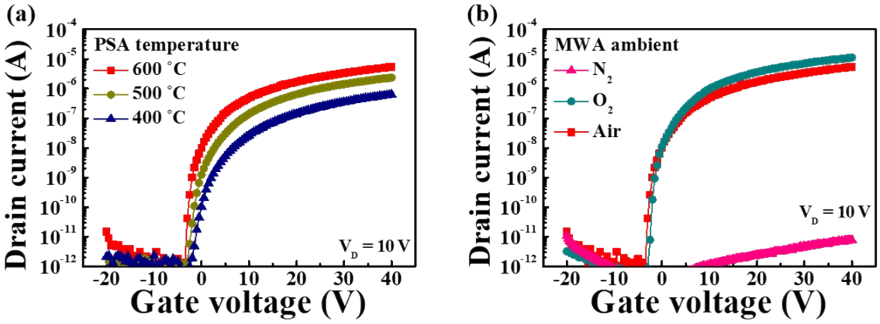

Figure S4. Transfer characteristic curves of IGZO nanofiber FETs according to (a) PSA temperature and (b) MWA ambient of air, O_2, and N_2 at MW power of 1800 W.