Supplementary Information

As illustrated in Figure S1a, flash light sintering uses photon energy for a short time, giving a pulse. This sintering method can lead to shorter sintering times than heat furnace sintering [32,33]. In Figure S1b, the green and yellow boxes indicate values typically used with flexible and rigid substrates, respectively. Recently, the multi-pulse sintering technique has been used because it gives improved densification [36].

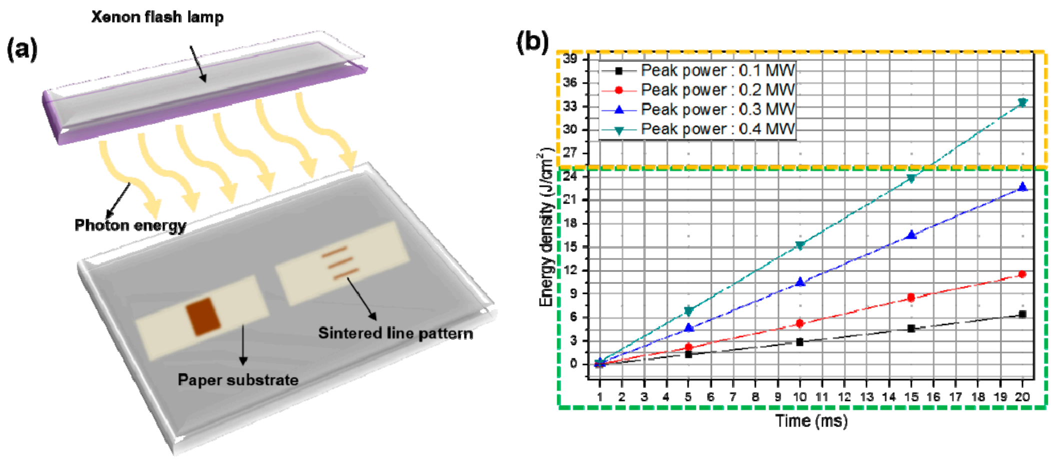

Figure S1. (**a**) Flash light sintering process and (**b**) relationship of energy density to peak power and time.

As shown in Figure S2a,b, we used photo paper with a thickness of 263 μm as the paper substrate. The top surface of the photo paper has a coating layer with a thickness of 40 μm. As shown in Figure S2c, the contact angle between the photo paper and copper nano-ink was 37.2°, which explains why it could successfully be wetted.

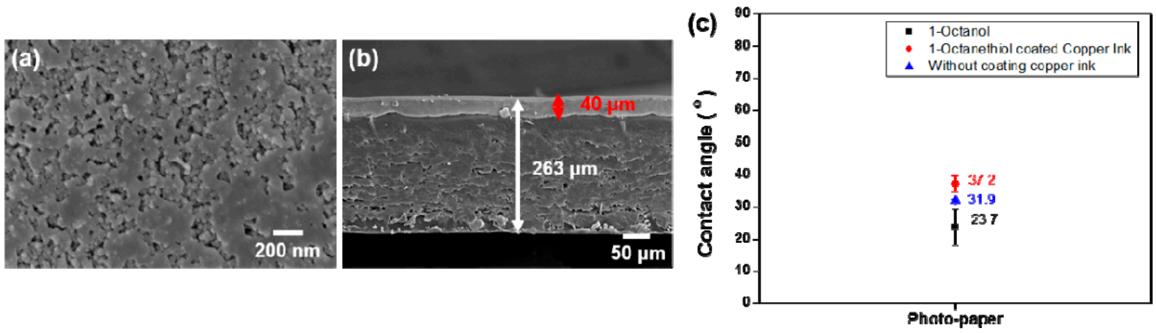

Figure S2. (**a**) Photo paper surface, (**b**) cross-sectional image, and (**c**) contact angle between the substrate and copper nano-ink.

For multi-step sintering, we used on-times of 1, 2, and 3 ms (duty cycles of 67%, 80%, and 86%, respectively) under the same energy density (15.6 J/cm^2). As shown in Figure S3, we calculated the duty cycle as (on-time/[on-time + off-time] × 100%). To determine optimal energy density for the multi-pulse flash light, we had tested other energy densities and measured their average resistivities of the printed patterns under the varying energy densities. As a result, energy density of 15.6 J/cm^2 was found to be the optimal energy density with the lowest average resistivity shown in Figure S4.

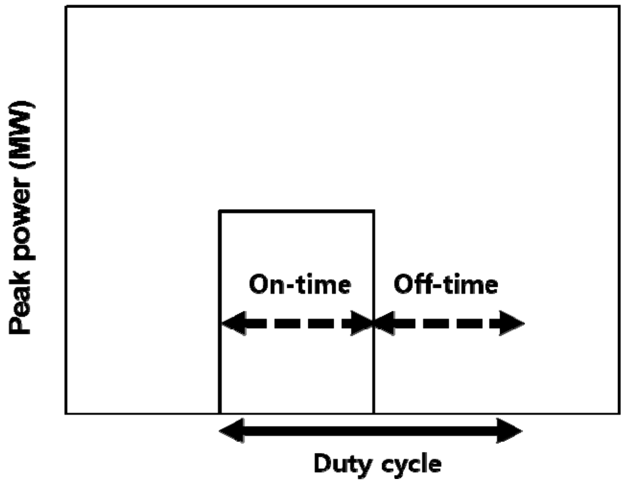

Figure S3. Relationship between duty cycle, on-time, and off-time.

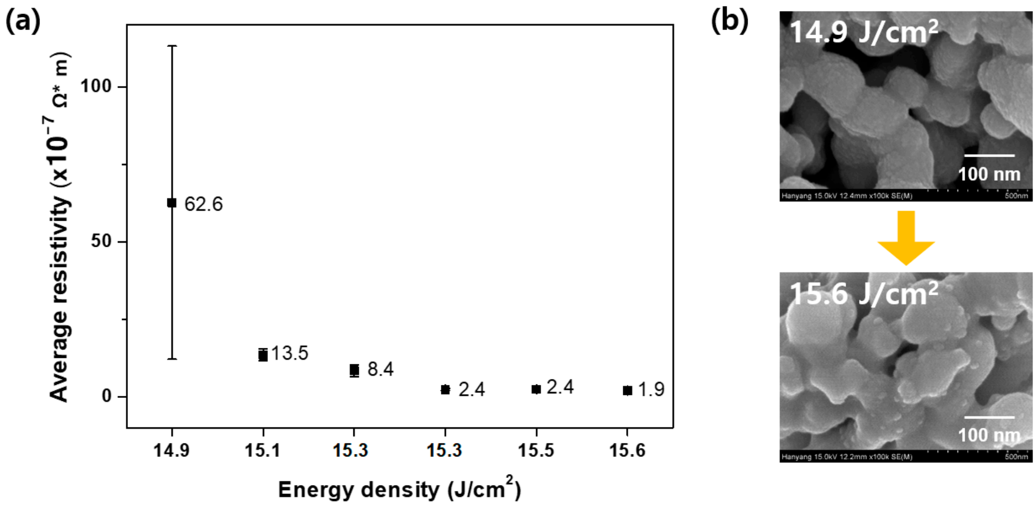

Figure S4. Results of multi-pulse sintering for various energy densities under the same condition with varying pulses: (**a**) resistivity measurements and (**b**) scanning electron microscope images.

Figure S5 shows X-ray photoelectron spectroscopy of multi-pulse light-sintered, inkjet-printed copper pattern on PI substrate under the energy density of 32.1 J/cm^2. The Cu-S bonding peak (S2p peak) at 162 eV was absent for this pattern since higher energy density easily removes sulfur and oxygen, as the copper pattern on the paper substrate under the energy density of 15.6 J/cm^2 still had Cu-S on its surface [Figure 6b].

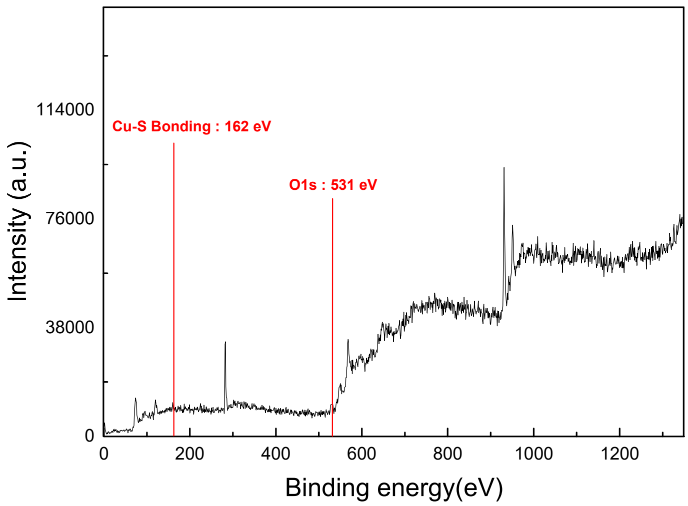

Figure S5. X-ray photoelectron spectroscopy of multi-pulse light-sintered, inkjet-printed copper pattern on PI substrate under the energy density of 32.1 J/cm^2.