Improving silver nanowires for FTCEs with flash light interactions

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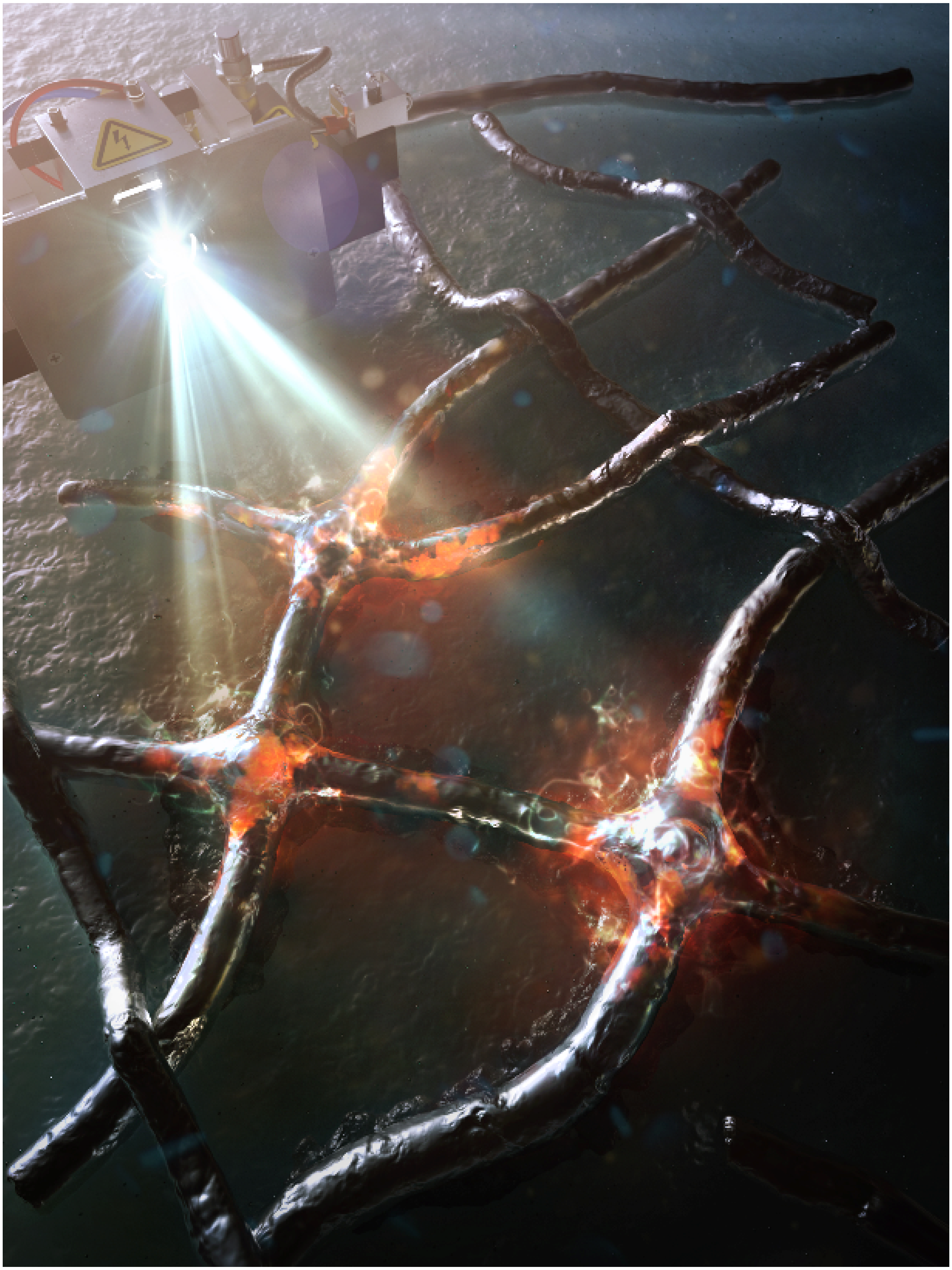


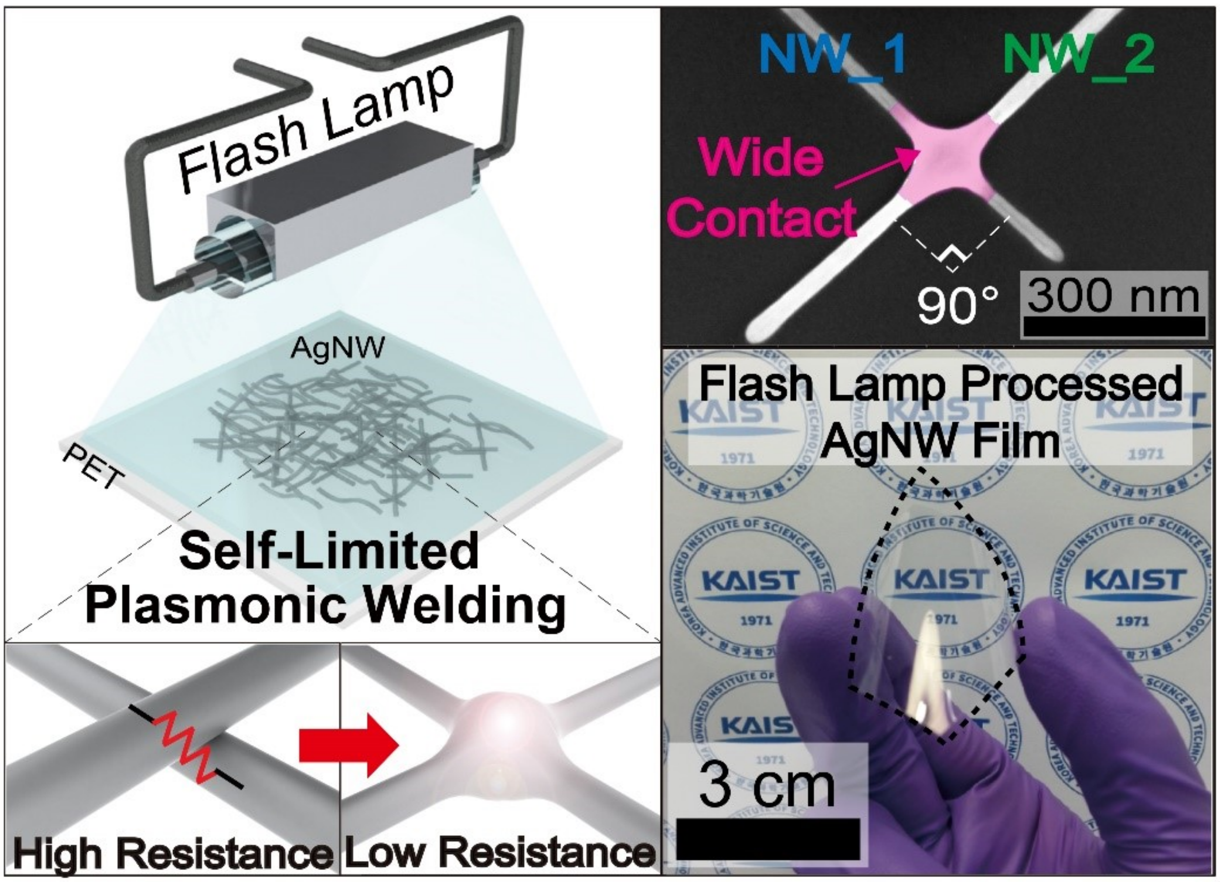
This image shows flash-induced plasmonic interactions with nanowires to improve silver nanowires (Ag NWs). Credit: KAIST

Flexible transparent conducting electrodes (FTCEs) are an essential element of flexible optoelectronics for next-generation wearable displays, augmented reality (AR), and the Internet of Things (IoTs). Silver nanowires (Ag NWs) have received a great deal of attention as future FTCEs due to their great flexibility, material stability, and large-scale productivity. Despite these advantages, Ag NWs have drawbacks such as high wire-to-wire contact resistance and poor adhesion to substrates, resulting in severe power consumption and the delamination of FTCEs.

A Korean research team led by Professor Keon Jae Lee of the Materials Science and Engineering Department at KAIST and Dr. Hong-Jin Park from BSP Inc., has developed high-performance Ag NWs (sheet resistance ~ 5 Ω /sq, transmittance 90 % at λ = 550 nm) with strong adhesion on plastic (interfacial energy of 30.7 J m-2) using flash light-material interactions.

The broad ultraviolet (UV) spectrum of a flash light enables the localized heating at the junctions of nanowires (NWs), which results in the fast and complete welding of Ag NWs. Consequently, the Ag NWs demonstrate six times higher conductivity than that of the pristine NWs. In addition, the near-infrared (NIR) of the flash lamp melted the interface between the Ag NWs and a polyethylene terephthalate (PET) substrate, dramatically enhancing the adhesion force of the Ag NWs to the PET by 310 %.

Professor Lee said, "Light interaction with nanomaterials is an important field for future flexible electronics since it can overcome thermal limit of plastics, and we are currently expanding our research into light-inorganic interactions."



The Ag NWs on a polyethylene terephthalate (PET) film after the flash-induced plasmonic thermal process. Credit: KAIST

Meanwhile, BSP Inc., a laser manufacturing company and a collaborator of this work, has launched new flash lamp equipment for flexible applications based on the Prof. Lee's research.

The results of this work entitled "Flash-Induced Self-Limited Plasmonic

Welding of Ag NW Network for Transparent Flexible Energy Harvester (DOI: 10.1002/adma.201603473) were published in the February 2, 2017 issue of *Advanced Materials* as the cover article.

Professor Lee also contributed an invited review in the same journal of the April 3 2017 online issue, "Laser-Material Interaction for Flexible Applications," overviewing the recent advances in light interactions with flexible nanomaterials.

More information: Jung Hwan Park et al. Flash-Induced Self-Limited Plasmonic Welding of Silver Nanowire Network for Transparent Flexible Energy Harvester, *Advanced Materials* (2017). DOI: 10.1002/adma.201603473

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