Welding of Metal Nanowire Networks Using Eddy Current Method

Ji Soo Oh[1], Da In Sung[1], Doo San Kim[1], Ki Hyun Kim[1] and Geun Young Yeom[1,2]

[1]Department of Advanced Materials Science and Engineering, SungKyunKwan University, Suwon, Gyeonggi-do 440-746, South Korea

[2]SKKU Advanced Institute of Nano Technology (SAINT), SungKyunKwan University, Suwon, Gyeonggi-do 440-746, South Korea

Silver nanowire (AgNW) network is one of the most promising candidates to replace indium tin oxide (ITO) as transparent conductors among several candidates such as carbon nanotubes, graphene, metal grid, conducting polymer, etc. AgNW has lots of advantages, for example, AgNW not only has inherent high electrical conductivity and high transparency but also can be easily fabricated by using various methods on the flexible substrates. Despite these advantages, AgNW has its limitations due to high surface roughness and low adhesion problem. Especially, a high contact resistance between AgNW from the coating of polyvinylpyrrolidone (PVP) due to the loose contact between individual AgNWs is a critical issue to be resolved.

In order to overcome these problems, we constructed an inductive coil system that generates eddy current and welded nanowires with different operating frequencies. This method welds only the junction between the nanowires without heating the substrate due to higher resistance at the junction. Using this method, the various metal nanowires such as Ag and Cu nanowires were successfully welded by reducing the sheet resistance about 67% without changing the optical transmittance, and it was confirmed that it can be applicable to various flexible dielectric substrates such PET substrates. Due to the local melting at the junction, the decrease of surface roughness could be also confirmed by surface image measurement. In addition, no significant change in resistance by bending test and adhesive test was observed due to the successful welding of the junction part of the nanowire, thereby improving the properties of the nanowire networks. This welding method is believed to be applicable to all kinds of metal nanowires without heating or toughing of substrate and on a large area at short process time and at low-cost.

Keywords: Nanowire, welding, eddy current, flexible transparent electrode