Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Supplementary information

High Conductivity and Stretchability of 3D Welded Silver Nanowire filled Graphene Aerogel Hybrid Nanocomposites

Jae Yoyng Oh,[a] Dongju Lee,[b,c] Gwang Hoon Jun,[d] Ho Jin Ryu*[e] and Soon Hyung Hong*[a]

a Department of Material Science and Engineering, Korea Advanced Institute of Science and Technology, 291 Daehak-ro, Yuseong-gu, Daejeon 34141, Republic of Korea

b Nuclaer Materials Devlopment Division, Korea Atomic Energy Research Institute, 989-111 Daedeok-daero, Yuseng-gu, Daejeon, 34057, Republic of Korea

c Korea Research Institute of Standards and Science, 267 Gajeong-Ro, Yuseong-Gu, Daejeon, 34113, Republic of Korea

dCorporate R&D, Research Park, LG Chem, 188 Moonji-ro, Yuseong-gu, Daejeon, 34122, Republic of Korea

e Department of Nuclear & Quantum Engineering, Korea Advanced Institute of Science and Technology, 291 Daehak-ro, Yuseong-gu, Daejeon 305-701, Republic of Korea

Corresponding Author

*E-mail : hojinryu@kaist.ac.kr

*E-mail : shhong@kaist.ac.kr

Microstructures of Graphene oxide and silver nanowires

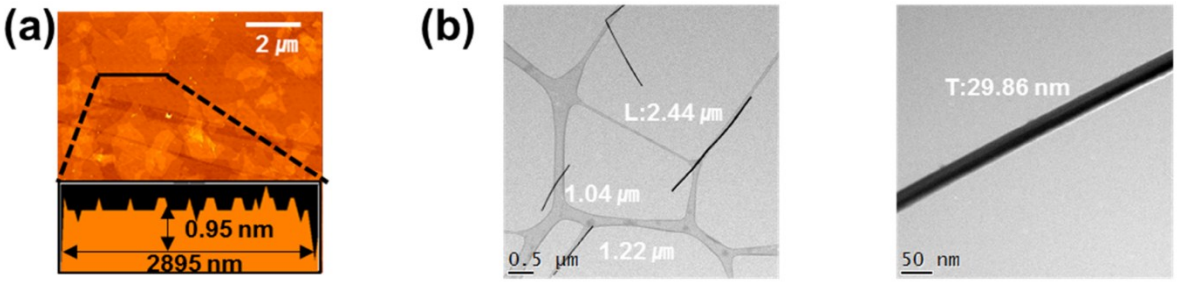

Fig. S1 (a) AFM images of graphene oxides and their thickness with lateral size (b) TEM images of silver nanowires and their thickness with length

Microstructures of silver nanowire film after thermal annealing

Electrical properties of silver nanowires were enhanced by thermal annealing due to removal of impurities and residual solvents. However, as shown figure S4, silver nanowires were damaged by thermal annealing above 200℃ and their electrical properties was degraded.

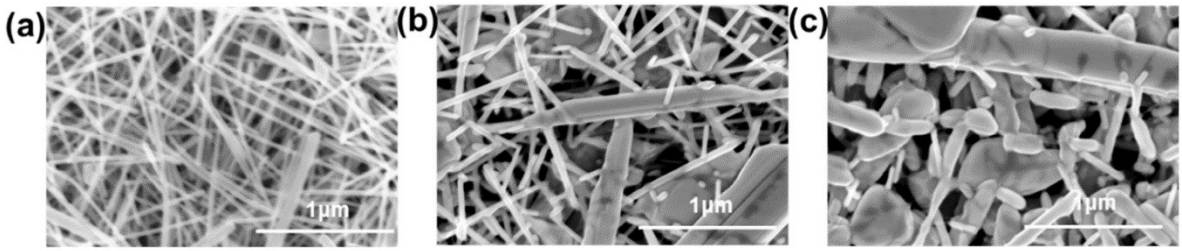

Fig. S2 Microstructure of (a) silver nanowire film annealed at 150 °C (b) silver nanowire film annealed at 200 °C (c) silver nanowire film annealed at 230 °C

Microstructure of optical treated silver nanowire films

There are no welded silver nanowires in optically treated silver nanowire films unlike optical welded silver nanowires in AgNW/GA nanostructures

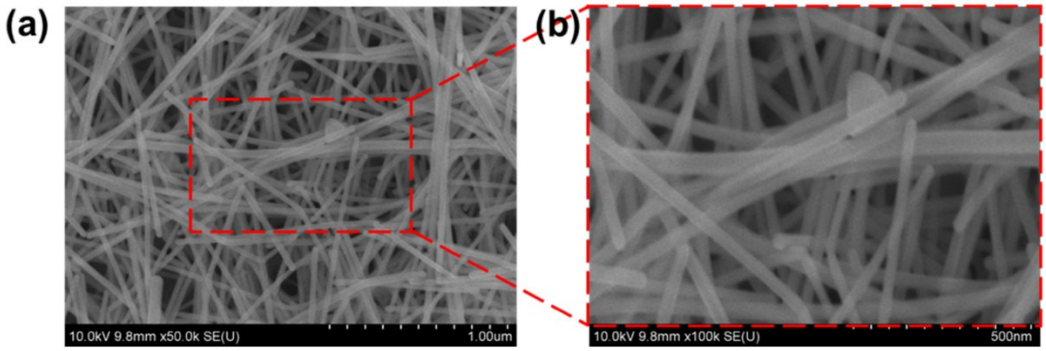

Fig. S3 Microstructure of (a) optically treated silver nanowire films and (b) their magnified image

Conductivity and stretchability comparison with previous researches

Group	Nanocomposites	Filler contents	Conductivity (S/cm)	Stretchability (%)	R/R_0 with strain
A (Adv. Mater., 2011)	SWCNT/PDMS	-	1.08	100	1.02 at 40% strain
B (Nat.Mater., 2011)	Graphene/PDMS	0.5 wt.%	10	95	1.13 at 40% strain
C (NPG Asia Mater., 2012)	Carbon nanofiber/PDMS	3 wt.%	0.41	118	1.05 at 40% strain
D (Angw. Chem. Int. Ed., 2013)	AgNW/(PUS)/PDMS	3 wt.%	14	140	1.24 at 50% strain
E (ACS Appl.Mater. Interfaces, 2014)	AgNW/Graphene/(PUS)/PDMS	0.3 vol.%	10	54	2.5 at 40% strain
F (Angw. Chem. Int. Ed., 2014)	AgNW/PDMS	1.5 wt.%	12.5	140	1.54 at 40% strain
G (ACS Nano, 2014)	CuNW/PDMS	3 vol.%	8.1	60	1.08 at 40% strain
H (RSC Advances, 2015)	AgNW/AgNP/(PUS)/PDMS	-	27.78	50	1.16 at 40% strain
I (Our results)	Our results	7.1 wt.% (0.7 vol.%)	42.8	78	1.12 at 40% strain

Fig. S4 Comparsion table of conductivity, stretchability and R/R_0 with strain

Mechanical properties of AgNW/GA/PDMS nanocomposites

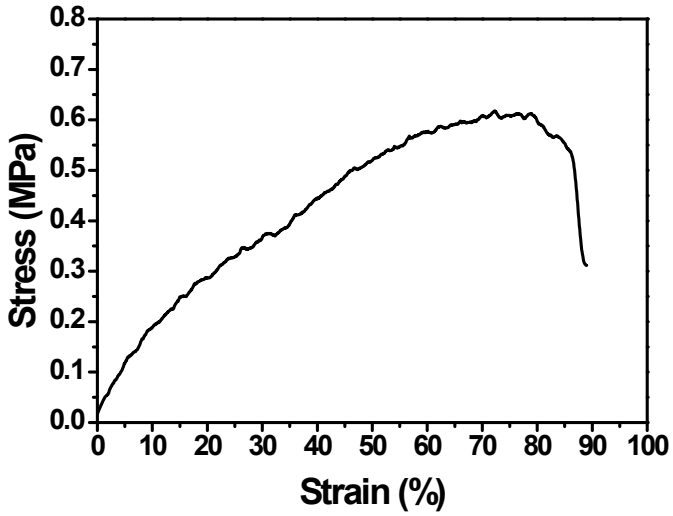

Fig. S5 Strain-Stress curve of AgNW(0.7 vol.%)/GA/PDMS nanocomposites

Microstructures of GA/PDMS and AgNW/GA/PDMS nanocomposites

By observing microstructures of GA/PDMS and AgNW/GA/PDMS nanocomposites, differences among them were confirmed and formation of silver nanowire networks in AgNW/GA/PDMS nanocomposites was confirmed.

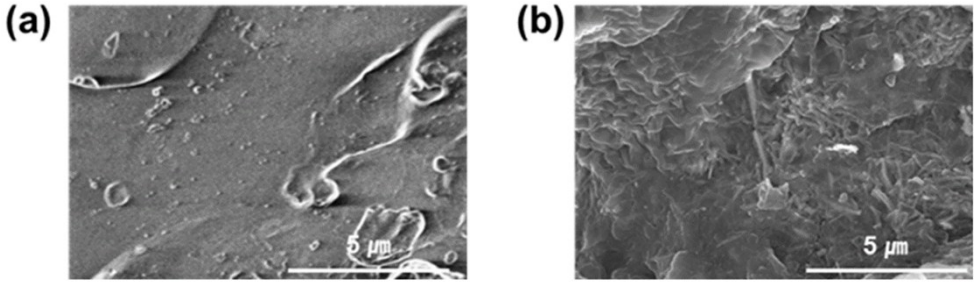

Fig. S6 Microstructures of (a) GA/PDMS and (b) AgNW/GA/PDMS nanocomposites

Comparison of microstructures and electrical conductivity as parts of the AgNW/GA/PDMS nanocomposites

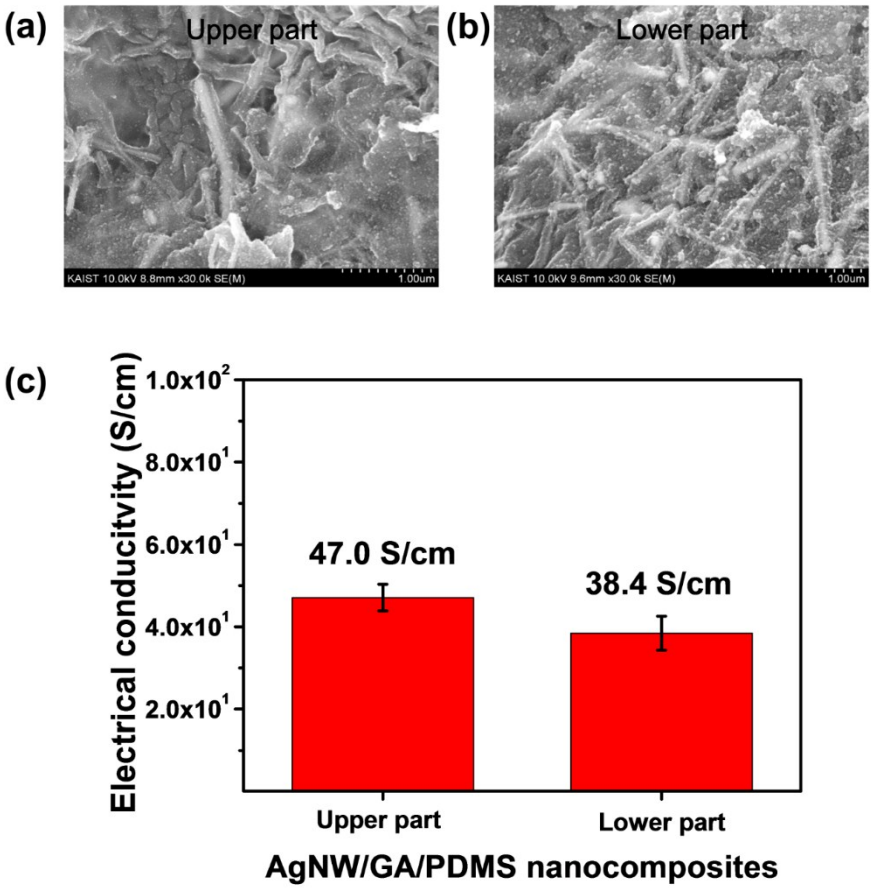

Fig. S7 Microstructures of (a) upper part (b) lower part in AgNW (0.7 vol.%)/GA/PDMS nanocomposites (c) Electrical conductivity as parts of the AgNW (0.7 vol.%)/GA/PDMS nanocomposites

Electrical conductivity changes of AgNW/GA/PDMS nanocomposites according to strain direction

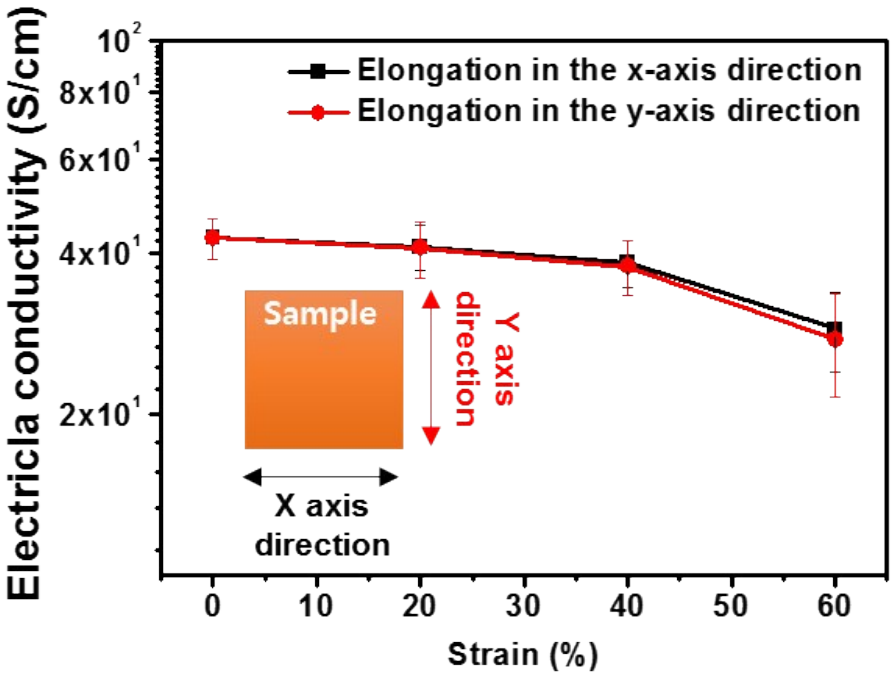

Fig. S8 Electrical conductivity curve of AgNW/GA/PDMS nanocomposites with strain direction

Electrical resistance changes of AgNW/GA/PDMS nanocomposites with strain

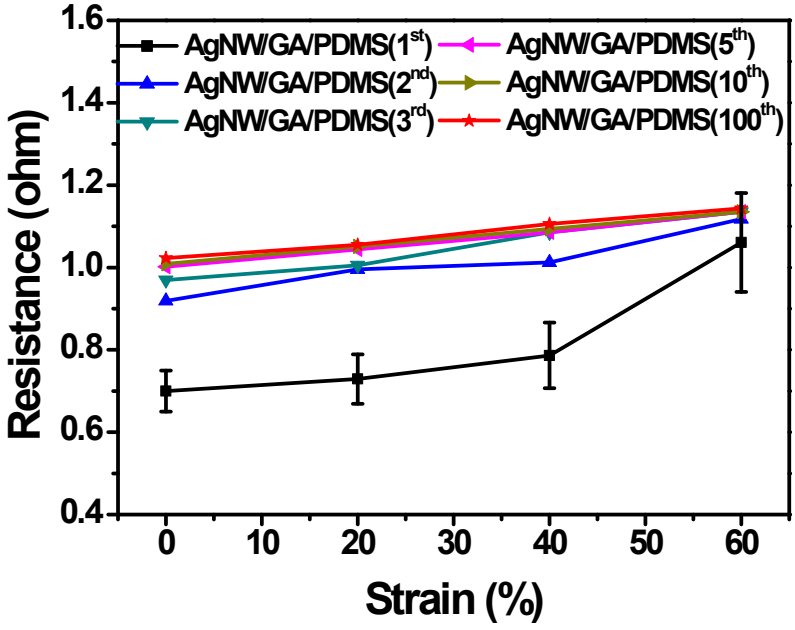

Fig. S9 Electrical resistance changes of AgNW/GA/PDMS nanocomposites according to stretching cycles