Electronic Supplementary Material (ESI) for Nanoscale.


# Electronic Supporting Information for "Highly Conductive and Transparent Coatings from Flow-aligned Silver Nanowires with Large Electric and Optical Anisotropy"

Ye Xu, [‡*abc] Dengteng Ge, [‡de] Gabriel A. Calderon-Ortiz,[b] Annemarie L. Exarhos,[b§] Coline Bretz,[c] Ahmed Alsayed,[c] Dave Kurz,[b] J. M. Kikkawa,[b] Remi Dreyfus,[c] Shu Yang,[d] and A. G. Yodh[b]

[a]*School of Mechanical Engineering and Automation and Center of Soft Matter Physics and its Applications, Beihang University, Beijing 100191, P.R. China. Email: ye.xu@buaa.edu.cn*

[b]*Department of Physics and Astronomy, University of Pennsylvania, Philadelphia, Pennsylvania 19104, USA*

[c]*Complex Assemblies of Soft Matter, CNRS-Solvay-UPenn UMI 3254, Bristol, Pennsylvania 19007, USA*

[d]*Department of Materials Science and Engineering, University of Pennsylvania, Philadelphia, Pennsylvania 19104, USA*

[e]*State Key Laboratory for Modification of Chemical Fibers and Polymer Materials, Institute of Functional Materials, Donghua University, Shanghai 201620, P.R. China*

## *Electrostatic torque* vs. *Hydrodynamic torque*

During the flow deposition, when a nanowire in the suspension gets in contact with the glass surface, it experiences both the hydrodynamic drag force by the shear flow, and the electrostatic force between the lightly charged nanowires and the glass surface. Those two forces are illustrated in Fig. S1.

For the hydrodynamic drag, the force acting on a unit length $dl$ of the nanowire is given by

$$F_{hydro} = \eta\dot{\gamma} l \sin^2\theta dl$$

The total torque applied by the hydrodynamic force is the integration of the length of the nanowire, $L$:

$$M_{hydro} = \int_0^L F_{hydro} l = \int_0^L \eta\dot{\gamma} l^2 \sin^2\theta \mathrm{dl} = \frac{\eta\dot{\gamma}\sin^2\theta L^3}{3}$$

For the electrostatic attraction, the force acting on a unit length $dl$ of the nanowire is given by

$$F_{elec} = \frac{\sigma\delta}{2\epsilon_0\epsilon_r} dl$$

The total torque applied by the electrostatic force is the integration of the length of the nanowire, $L$:

$$M_{elec} = \int_0^L F_{elec} l\cos\theta = \int_0^L \frac{\sigma\delta l\cos\theta}{2\epsilon_0\epsilon_r} dl = \frac{\sigma\delta L^2\cos\theta}{4\epsilon_0\epsilon_r}$$

Therefore, we can construct a non dimensional number, which allows us to compare the importance of the electrostatic torque relative to the hydrodynamic torque:

$$\frac{\mathrm{M_{hydro}}}{\mathrm{M_{elec}}} \approx \frac{4}{3}\frac{\gamma\eta\mathrm{L}\epsilon_0\epsilon_\mathrm{r}}{\delta\sigma}\frac{\sin^2\theta}{\cos\theta}$$

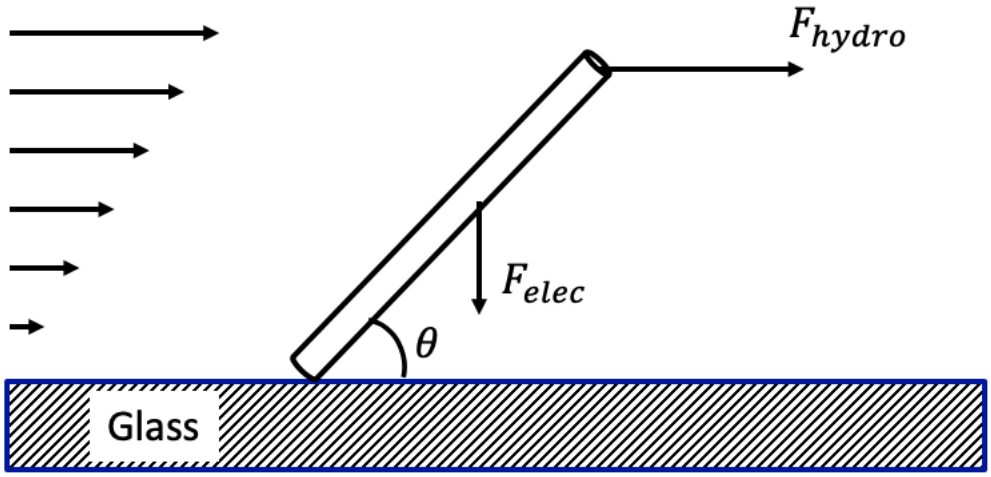


Figure S1. Illustration of the hydrodynamic drag force and electrostatic force acting on a nanowire in a shear flow when one end of the nanowire gets contact with the surface.

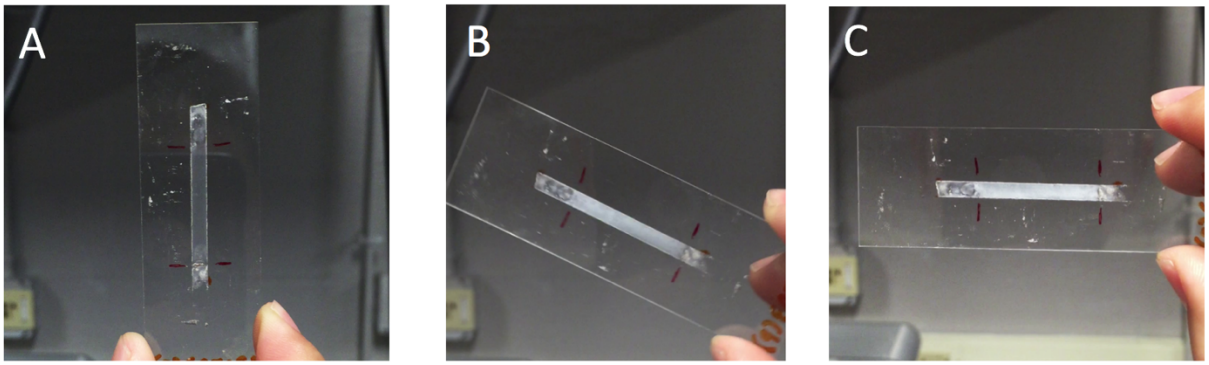


Figure S2. Observation of deposited AgNW coating sample under different orientation show angle-dependent transparency.

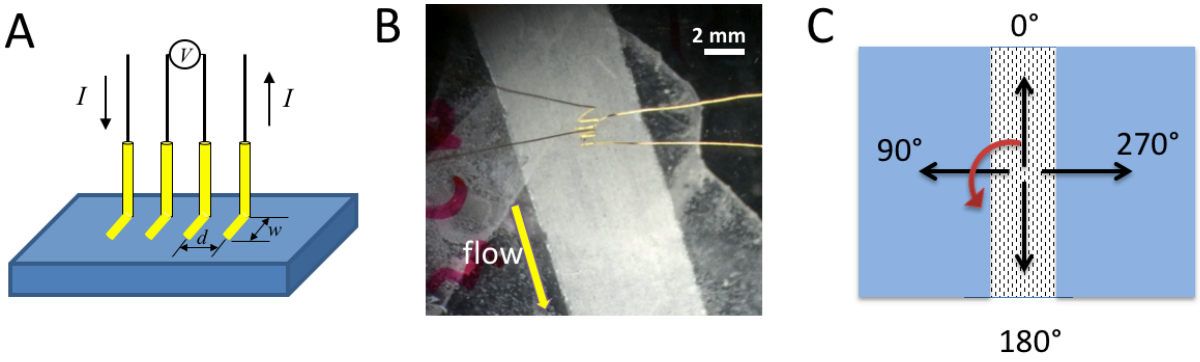


Figure S3. *Sheet resistance setup.* (A) Schematic showing the geometry and arrangement of four probes. (B) Photographs of four gold leads and the AgNW coating in sheet resistance measurement. (C) Schematic showing the angles of sheet resistance measurements relative to the alignment of AgNWs.