Forming of silver nano-ribbons with ultrasonic pressure process

Objective

To obtain silver nano-ribbons through plastically deforming of silver nanowires by an ultrasonic pressure process, also to investigate the hardness of the obtained silver nano-ribbons by atomic force microscopy.

Sample Preparation

Silver nanowires with diameters of 45–50 nm and lengths of 15–25 μm were subjected to deformation process using a precision ultrasound equipment. The pressures of the indenter were 0.1-0.3 MPa with ultrasonic times of 0.1-1.2 seconds and applying an ultrasonic power of 20 kHz.

Data acquisition

The force-distance curve test was conducted on the Ag nano-ribbons using an atomic force microscope (Dimension ICON, Bruker, Germany). To obtain the micro-hardness of silver nano-ribbons was used 100 points of the nanosilver material under the input energy of 0, 0.18 and 0.36 Mpa.S for the measurement.

Representative figures & Results

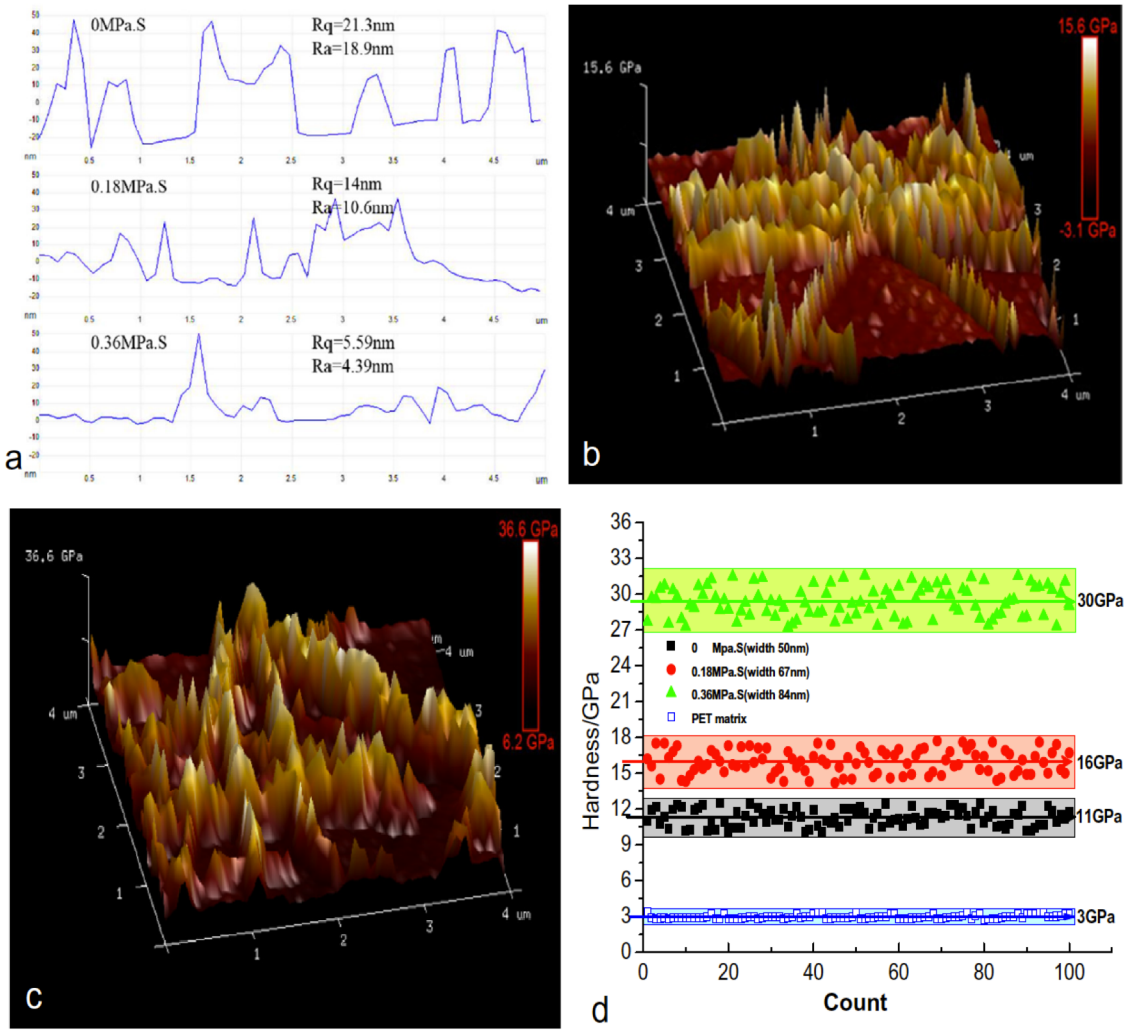

Fig. 3. Roughness and hardness modulus of Ag nano-ribbons with different input energy: a) Roughness of PET surface with Ag nanoribbons, b) 0 MPa.s; c) 0.36 MPa.s and d) Statistics of hardness modulus.

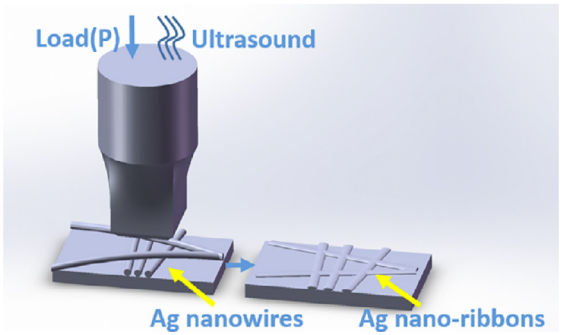

Fig. 1. Ultrasonic processing for forming Ag nano-ribbons.

Conclusion

Ultrasonic pressure processing allows deforming Ag nanowires to obtain Ag nanobelts with different degrees of flattening. The press value and press time define the deformation level. As a result of the flattening process, silver nanoribbons exhibit work hardening phenomenon as the bulk silver material.