

Conditioning of Metal Nanowires in Liquids by Laser Processing

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Metal nanowires and nanoparticles have become popular objects for various studies and different applications, from transparent electrodes [1] to drug delivery and medical imaging [2]. Metal nanodumbbells, a “hybrid” of a nanowire and nanoparticles, have recently raised interest as an experimental object in nanotribology and nanomanipulations [3].

We present a novel method of conditioning of metal nanowires in order to transform them into the nanodumbbell structures. A glass cell containing a suspension of metal nanowires has been placed on the magnetic stirrer (Fig.1). An unfocused laser beam with diameter of 0.6 mm and pulse energy of about 0.9 mJ with repetition rate of 500 Hz and pulse width of 9 ns has been used to irradiate the nanowires. As a result of the absorption of the laser pulse energy, the thermal gradient occurs causing the initiation of the melting process at the ends of the nanowires. The formation of the near-spherical end bulbs follows by the cooling of the nanowire down and rapid solidification and crystallisation of the dumbbell.

The proposed method offers an effective and reliable way to produce metal nanodumbbells from the metal nanowires. After the laser processing, both the end bulbs and the connecting nanowire of a metal nanodumbbell preserve their crystallinity (Fig. 2).

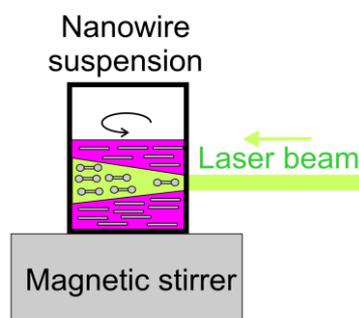


Figure 1. Schematics of the experimental setup.

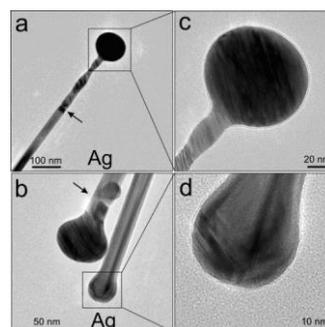


Figure 2. TEM images of the end bulbs of silver nanodumbbells. Grain boundaries are indicated by the arrows [3]

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References

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