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Arc Discharge Drawing Silica Nanowires

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We propose a new approach, the Arc Discharge Drawing (ADD) technique, to fabricate silica fibers with diameters less than the wavelength of commercial available lasers. With this single-step technique, silica wires with diameters as small as 50 nm were demonstrated. This technique would provide an attractive alternative to current approaches to fabricate the silica nanowires. For ADD technique, a standard optical fiber is placed in two fiber mounts. One of the fiber mount performs as the computer-controlled stage that pulls the fiber at various speeds in the range of 2 mm/s to 15 mm/s. During this computer-controlled fiber drawing process, the fiber is heated by the arc discharge serving as the heat source. The arc discharge is supplied with a D.C. current from a rectifier with a controlled voltage to 20 kV. The nanowires can be fabricated by varying the voltage in the range of 4 kV to 5 kV. The optimum operational voltage is determined by the scanning electron microscope (SEM) images of the fabricated silica nanowires. Based on the SEM images, it is evident that nanowires obtained by the ADD technique exhibit great diameter uniformity and large length. In addition, the fabricated silica nanowires are flexible due to their large aspect ratio between the diameter and the length. Furthermore, the nanowires can be bent and twisted without breaking.The bent and twisted silica nanowires are extremely useful to guide laser light for small scale photonic devices. In this study, the nanowires obtained by ADD technique were also investigated in the aspect of guiding 633-nm wavelength light. The results reveal the high transmission losses thus providing the greater evanescent field. This represents a significant advancement in the field of nanophotonics. Due to their extraordinary compactness and excellent optical properties, nanowires will find a whole range of nanoscale photonic devices.

Summary

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