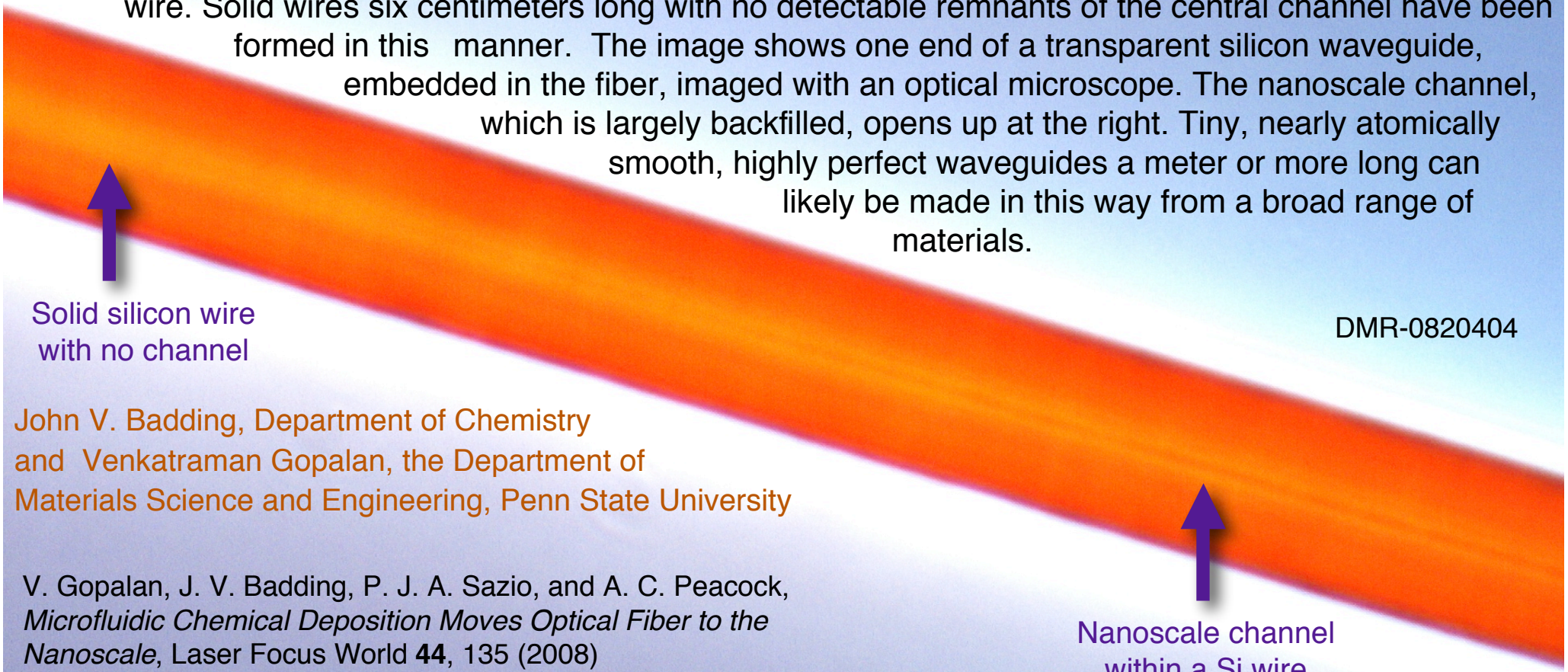
Construction within Tight Spaces: Solid Silicon Waveguides formed in Optical Fibers

Waveguides - structures that can transport and manipulate light - are critically important to the modern information superhighway and many other areas of science and technology. MRSEC researchers filled empty nanoscale or microscale pores in optical fibers and related very high aspect-ratio structures with solid silicon wires by chemical deposition from high pressure fluids flowing within the pores. Silicon waveguides that can guide, switch and change the wavelength of infrared light are deposited layer-by-layer on the pore walls from a central channel that gradually narrows as deposition proceeds. Even after this nanochannel necks down and closes off, it is still possible to back-fill it to form an essentially solid silicon wire. Solid wires six centimeters long with no detectable remnants of the central channel have been formed in this manner. The image shows one end of a transparent silicon waveguide, embedded in the fiber, imaged with an optical microscope. The nanoscale channel, which is largely backfilled, opens up at the right. Tiny, nearly atomically smooth, highly perfect waveguides a meter or more long can likely be made in this way from a broad range of materials.



Solid silicon wire with no channel

Nanoscale channel within a Si wire

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V. Gopalan, J. V. Badding, P. J. A. Sazio, and A. C. Peacock, *Microfluidic Chemical Deposition Moves Optical Fiber to the Nanoscale*, Laser Focus World **44**, 135 (2008)